JAN 24 1927

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The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

PROGRESS OF THE

ENGINEERING, SHIPBUILDING,

AERONAUTICAL

and

TRANSPORT INDUSTRIES

in 1926.

PUBLIC NOTICES

Army Contracts.

NOTICE IS HEREBY GIVEN that TENDERS for QUANTITIES of the undermentioned MANUFACTURED GOODS are invited from time to time as required :—

METAL TRADES, &c.:
Aluminium Castings and Pressings, Bedsteads, Cutlery, Copperware, Enamelled Ware, Fencing (Woven Wire and Strained Iron Wire), Field Forges, Hollow-ware, Lamps and Lanterns, Nails, Saddletrees, Safety Razors and Blades, Sash Chains, Scratch Card, Screws, Shovels, Stoves, Grates, &c., Telegraph Poles (Iron), Tin-plates, Tinware, Tools, Tubing, Wire.

TEXTILE TRADES, &c.:
American Cloth, Blankets, Braids, Buckram, Canvas, and Canvas Goods, Cloth, Cordage, Cottons and Cotton Goods, Cotton Waste, Cotton Waste for Guncotton, Embroidery, Flags, Flannel, Head-dresses (including Bearskin Caps), Horse Rugs, Hosiery (including Hose Tops), Linens and Linen Goods, Moquette, Puttees, Sewing Cotton and Thread, Silk, Sponge Cloths, Stockinette, Tapes, Tents, Webs, Worsted Gloves.

ELECTRICAL AND SCIENTIFIC INSTRUMENT TRADES :
Cables, Electrical Stores, Scientific Instruments.

GENERAL TRADES :
Acid-resisting Stoneware, Boots and Shoes, Boxes and Chests, Brushes and Brooms, Candles, Chemicals (including Acetone, Alcohol, Aluminium Powder, Anhydrous Ammonia, Barium Nitrate, Magnesium Powder, Soda), Chinaware, Combs, Cooperage, Earthenware, Furniture, Glassware and Splinterless Glass, India Rubber Goods, Leather Goods, Paint (including Paint, Zinc Oxide, Dry), Powdered Ivory Nut, Soap, Stable Fittings, Timber, Uniform Clothing (made up from the Department's own Materials), Vehicles, Woodware.

Manufacturers who are not already on any War Office list of tenderers, and who may wish to be invited to Tender for Army requirements of the above stores, should apply to the Director of Army Contracts at the address given below for Form 1, on which formal application for inclusion on the list of tenderers may be made. The services of an intermediary are unnecessary in approaching the Department for this purpose.

Before being placed on the lists of tenderers, firms will have to satisfy the Department that they actually manufacture goods for which they wish to be noted, and will be required to furnish the names of at least two well-known firms or public bodies who have purchased from them and are in a position to certify as to the quality of their productions. They will further have to give an undertaking that they will comply with the Fair Wages Resolution of the House of Commons.

Attention is called to the following resolution passed by both Houses of Parliament on 19th February, 1926 :—

"That in the opinion of this House, it is the duty of the Government in all Government contracts to make provision for the employment to the fullest possible extent of disabled ex-Service men, and to this end to confine such contracts, save in exceptional circumstances, to employers enrolled on the King's National Roll."

SALES.—From time to time the Department has for sale surplus Army stores of various descriptions, among which may be mentioned :—Machinery, Electrical Stores, Hutting, Mechanical Transport, Drugs, Medical and Dental Stores, Veterinary Stores, Laboratory Apparatus, Clothing, Textiles, Scrap Metals. Firms who wish to be invited to Tender for the purchase of surplus stores should apply as directed below.

All applications should be in writing and should be addressed to the DIRECTOR OF ARMY CONTRACTS, Caxton House (West), Tothill-street, Westminster, London, S.W. 1. No application is necessary from firms whose names are already on the War Office lists.

N. F. B. OSBORN,
4372 Director of Army Contracts.

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
400,000 MILD STEEL DISTANCE PIECES FOR SLEEPERS.
Tenders due on the 25th January, 1927.
Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 4414

An Assistant Executive BRIDGE ENGINEER is REQUIRED for the service of Indian State Railways. Preference will be given to a candidate who has passed the A.M. Inst. C.E. examination or who possesses a B.Sc. degree or diploma of a recognised Engineering College.
The selected candidate must have had a good mechanical engineering training, and be capable of taking charge of heavy bridge construction plant, and bridge construction, girder erection, coffer damming, pile driving and reinforced concrete, and railway bridge work under traffic. Age not exceeding 30 years. Salary on appointment Rs. 525 plus £15 overseas pay per month.
The agreement will be for three years in the first instance, with provision for extension beyond that time with the consent of both parties. A first-class free passage to India will be provided. Leave, Provident Fund and gratuity in accordance with the rules applicable to officers of the Indian State Railways.
Applicants must give full particulars of their theoretical and practical training and experience and state their age and whether married or single. Applications, accompanied by COPIES ONLY of testimonials, should be addressed not later than 17th January, 1927, to RENDEL, PALMER and TRITTON, 12/14, Dartmouth-street, London, S.W. 1. 4362

The High Commissioner for India REQUIRES an ASSISTANT ENGINEER INSPECTOR (Mechanical) for service in England. The post is on a non-pensionable basis and will be held in the first instance on probation for two years, during which period the services of the incumbent may be dispensed with at one month's notice. Thereafter service will be terminable by six months' notice on either side.
Salary £150, rising by annual increments to £300. Prospect of £310, rising by annual increments to £400, by promotion to Inspector. These salaries carry a variable cost-of-living bonus on the Civil Service scale. At present the bonus on £150 amounts to £82.
Candidates should be 28 to 35 years of age, have good technical and shop training and have held some position of responsibility. All-round rather than specialised experience is desirable. Preference given to A.M.I. Mech. E. or equivalent. Previous inspection experience not essential.
Applications, stating age, training and experience, and enclosing COPIES of recent testimonials, to be sent to the DIRECTOR-GENERAL, India Store Department, Belvedere-road, Lambeth, S.E. 1, not later than the 15th January, 1927. 4392

Assistant Engineers (4) REQUIRED for the NIGERIAN GOVERNMENT RAILWAY (Construction) for a tour of 12 to 18 months, with possible extension. Free passages and a commuted bush and travelling allowance of £9 a month whilst on duty in the Colony. Camp equipment provided. Outfit allowance of £60 on first appointment. Liberal leave on full salary. Salary £480 for the first three years of service, then £510, rising to £720 a year by annual increments of £30, and thence rising to £920 a year by annual increments of £40. Candidates must have passed examination to qualify for A.M.I.C.E. or hold equivalent professional qualifications and possess experience on railway location.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, clearly quoting M/14209. 4377

Civil Engineers (4) Required for the PUBLIC WORKS DEPARTMENT of TANGANYIKA TERRITORY for a tour of 20 to 30 months' service, with possible extension. Salary £480, rising by annual increments to £720 a year (with efficiency bar at £600). Outfit allowance of £30 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25 to 35, preferably unmarried, must have been regularly trained as Civil Engineers, and be Corporate Members of the Institution of Civil Engineers. Must be capable of Levelling, Surveying, Measuring-up Work and Preparing Designs of Bridges, &c. Must have had at least three years' experience under a qualified Civil Engineer on the Construction of Harbour Works, Drainage Works, Water Supply or other Public Works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14402. 4424

Engineers (2) Required by the GOVERNMENT of KENYA for Road Surveys, for a tour of 20 to 30 months' service, with possible extension. Salary £650 a year. Free quarters and passages and liberal leave on full salary. Candidates, age 25 to 45, should be fully trained Civil Engineers, preferably Corporate Members of the Institution of Civil Engineers, experienced in location surveys for roads or railways, neat and rapid draughtsmen, with good experience in bridge design and in estimating. Colonial experience preferred.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14730. 4356

Indian Railway Service OF ENGINEERS.
The Secretary of State for India is about to make 4 APPOINTMENTS of ASSISTANT EXECUTIVE ENGINEER in this service. European British subjects of non-Asiatic domicile only are eligible.
Age limits, 21 to 25 on 1st August, 1927.
QUALIFICATIONS.—Candidates must (a) possess one of certain University degrees, or (b) have passed Sections A and B of the A.M.I.C.E. examination or have been exempted from that examination, or (c) produce evidence that they are otherwise qualified under the regulations, and must have had not less than one year's practical experience of civil engineering under a qualified Civil Engineer on the date of appearance before the Selection Committee.
Last day for applications, 1st April, 1927.
Application forms and full particulars obtainable from the SECRETARY, Services and General Department, India Office, Whitehall, S.W. 1. 4361

Crystal Palace School of Practical Engineering. Founded 1872.
PRINCIPAL : MAURICE WILSON, M. Inst. C.E., F.S.E.
VICE-PRINCIPAL : F. C. P. LAWRENCE, M.S.E., M. Inst. Struct. E.
The NEW SESSION will COMMENCE JANUARY 12th, 1927. 4371

Northampton Polytechnic INSTITUTE, ST. JOHN-STREET, E.C. 1.
CHEMISTRY DEPARTMENT.
A COURSE OF SIX LECTURES on "STEEL AND ITS THERMAL TREATMENT" will be given by
R. GENDERS, Esq., M.B.E., B.Met., F.I.C., On THURSDAY EVENINGS, at 7 p.m., Commencing on JANUARY 13th, 1927.
JAN. 13TH.—Wrought Iron and Shear Steel. The manufacture of malleable iron by puddling and its conversion into shear steel. The properties of these materials.
JAN. 20TH.—The Carbon Steels. The effect of carbon on the properties and structure of iron. The principles of modern methods of steel manufacture.
JAN. 27TH.—The Heat Treatment of Carbon Steels. Changes on heating and cooling and the manner in which these changes affect the structure and properties of steel on hardening and tempering.
FEB. 3RD.—Engineering and other Special Steels. The effects of nickel, chromium, manganese, tungsten, and other elements on carbon steels. Stainless steels, motor and aeronautical steels, high-speed steel, and manganese steel.
FEB. 10TH.—Defects in Steel. Common defects originating in casting and hardening and their origin. Examination of defects.
FEB. 17TH.—Cast and Malleable Cast Iron. Properties and manufacture. Recent developments.
The above subjects will be treated mainly from the engineering standpoint.
Admission free.
S. C. LAWS, M.A., M.Sc., Principal.
4370

Huddersfield Education Committee. HUDDERSFIELD TECHNICAL COLLEGE
(Principal : J. F. HUDSON, M.A., B.Sc.)
APPLICATIONS are INVITED for the POSITION of ASSISTANT LECTURER and DEMONSTRATOR in the Department of Mechanical Engineering. Good experience of experimental work in Applied Mechanics and Heat Engines is an essential qualification. Graduate preferred. Salary in accordance with the Burnham Scale. Statement of duties and form of application may be obtained on receipt of a stamped addressed foolscap envelope, and must be returned not later than Friday, 14th January, 1927.
L. G. THORNBER, Director of Education.
Education Offices, Huddersfield. 4316

Bombay, Baroda and Central India Railway Company.
The Directors are prepared to receive up to Noon on Friday, 21st January, TENDERS for the SUPPLY of :—
1. TYRES for LOCOMOTIVES.
2. WHEELS and AXLES for CARRIAGES.
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each, which will not be returned.
The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S. YOUNG, Secretary.
Offices : 91, Petty France, Westminster, S.W. 1.
3rd January, 1927. 4394

PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
Notice is Hereby Given that WAYGOOD-OTIS, Limited, whose registered offices are at 54 and 55, Fetter-lane, London, E.C. 4, a British Company ; THOMAS HUBERT JOHN SIMMONS, a British subject ; and EDWARD CLEMENCE, a British subject, both of 54 and 55, Fetter-lane, London, E.C. 4, SEEK LEAVE to AMEND the SPECIFICATION of the APPLICATION for LETTERS PATENT No. 259,362, for an invention entitled "Improvements in or relating to Locking Gear for the Landing Gates of Lifts and the like."
Particulars of the proposed amendment were set forth in the Illustrated Official Journal (Patents) of the 30th December, 1926.
Any person or persons may give Notice of Opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. S. JARRATT, Comptroller-General.
Feeny and Feeny, Chartered Patent Agents, 73A, Queen Victoria-street, London, E.C. 4. 4359

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
Notice is Hereby Given that HEINRICH REISER, of 130, Viktoriastrasse, Gelsenkirchen, Germany, of German nationality, SEEKS LEAVE to AMEND the SPECIFICATION of the APPLICATION for LETTERS PATENT No. 259,681, for an invention entitled "Improvements in Cooling Arrangements for the Masonry of Pulverised Coal-fired Furnaces." Particulars of the proposed amendment were set forth in the Illustrated Official Journal (Patents) of the 30th December, 1926.
Any person or persons may given Notice of Opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. S. JARRATT, Comptroller-General.
4384

Bengal-Nagpur Railway Company, Limited.
The Directors are prepared to receive TENDERS for :—
STEEL FOR SPRINGS.
Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 4th January, 1927.
A fee of 20s. will be charged for the specification, which is NOT returnable.
Tenders must be submitted not later than Noon on Friday, 14th January, 1927.
The Directors do not bind themselves to accept the lowest or any Tender and reserve to themselves the right of reducing or dividing the order.
By Order of the Board.
B. C. VOLKERS, Secretary.
4360

Bengal-Nagpur Railway Company, Limited.
The Directors are prepared to receive TENDERS for :—
SQUARE AND FLAT STEEL BARS.
Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 5th January, 1927.
A fee of 10s. will be charged for the specification, which is NOT returnable.
Tenders must be submitted not later than Noon on Wednesday, 12th January, 1927.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board.
R. C. VOLKERS, Secretary.
4391

Bengal-Nagpur Railway Company, Limited.
The Directors are prepared to receive TENDERS for :—
ROUND STEEL BARS.
Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 6th January, 1927.
A fee of 10s. will be charged for the specification, which is NOT returnable.
Tenders must be submitted not later than Noon on Thursday, 13th January, 1927.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board.
R. C. VOLKERS, Secretary.
4412

Commonwealth of Australia, Postmaster-General's Department.—TENDERS INVITED, Schedule V. 468, for the SUPPLY and INSTALLATION of PNEUMATIC TUBE SERVICE in Melbourne.—Tender forms obtainable from SUPPLY OFFICER, Australia House, Strand, W.C. 2. Tenders close 8th March, 1927. 4290

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PUBLIC NOTICES

City of Winchester.

MAIN DRAINAGE.
CONTRACT NO. 2.
TO CONTRACTORS.

The Corporation of Winchester are prepared to receive TENDERS for the CONSTRUCTION of 5 SETTLEMENT TANKS with GAUGE HOUSE; the CONSTRUCTION of 11 SLUDGE BEDS, SMALL FILTER and HUMUS TANK; the ERECTION of a HIGH-LEVEL PUMP HOUSE, and LINES of PIPES in connection with their Sewage Farm, which is about 2½ miles from Winchester Station (Southern Railway) and three quarters of a mile from Winchester Station (Great Western Railway); all in accordance with plans and specification prepared by the Engineers, Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.

Copies of the specification, bill of quantities and form of Tender may be obtained from and the drawings may be seen at the offices of the Engineers upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

Sealed Tenders, endorsed "Winchester Drainage, Contract No. 2," addressed to the undersigned at the Guildhall, Winchester, must be received before Noon on Monday, the 24th day of January, 1927.

The Corporation do not bind themselves to accept the lowest or any Tender.

By Order,
THOMAS HOLT,
Town Clerk.

The Guildhall, Winchester. 4382

Farnham Urban District

COUNCIL.
WATERWORKS.
CONTRACT NO. 3.
TO CONTRACTORS.

The Urban District Council of Farnham are prepared to receive TENDERS for the CONSTRUCTION of a BORED and LINED WELL about 200ft. deep, and for the PROVISION, FIXING and WORKING a TEMPORARY AIR LIFT PUMP for a period of 14 days to test the yield up to 375,000 gallons per 24 hours; also for the CONSTRUCTION of a CONCRETE SETTLING TANK, with the necessary CAST IRON PIPE CONNECTIONS and MAINS.

The drawings can be seen at, and the specification, bill of quantities and form of Tender obtained from, the offices of the Engineers, Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1, upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

Sealed Tenders, endorsed "Waterworks, Contract No. 3," addressed to the undersigned at his office at Farnham, must be received before Noon on Saturday, the 22nd day of January, 1927.

The Council do not bind themselves to accept the lowest or any Tender.

By Order,
J. W. WRIGHT,
Clerk.

Council Offices, Farnham, Surrey. 4374

Metropolitan Borough of

HAMMERSMITH.
ELECTRICITY DEPARTMENT.

The undermentioned superseded PLANT, installed at Hammersmith Electricity Works, is offered FOR SALE, viz., THREE BABCOCK and WILCOX BOILERS with SUPERHEATERS.

Specification and full particulars from the Engineer and Manager, Electricity Department, 85, Fulham Palace-road, London, W. 6.

The dismantling and removal of the plant to be carried out by the purchaser at his own expense and risk.

Offers must be submitted to the Town Clerk, Town Hall, Hammersmith, W. 6, endorsed "Tender for Old Boilers," not later than 4 p.m. on Friday, 21st January, 1927.

HUGH ROYLE,
Town Clerk.

Town Hall, Hammersmith, W. 6.
3rd January, 1927. 4357

South Indian Railway Company,

LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of—

1. SPARE PARTS of CARRIAGES and WAGONS.
2. STEEL CRANKED FISH-PLATES.
3. LOCOMOTIVE TURNTABLE.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Spare Parts of Carriages and Wagons," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 21st January, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of specification No. 1, 10s. for each copy of specification No. 2, and 5s. for each copy of specification No. 3.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
5th January, 1927. 4425

Southport, Birkdale and West

LANCASHIRE WATER BOARD.
TENDERS FOR CAST IRON OR STEEL WATER PIPES.

The Water Board invite TENDERS from British Manufacturers for the SUPPLY and DELIVERY to Southport of about 337 TONS of CAST IRON SPIGOT and SOCKET PIPES, 12in. in diameter, or alternatively an equivalent length of STEEL PIPES lined internally and protected externally.

Specifications and conditions of contract may be obtained upon application to the undersigned, to whom sealed Tenders are to be delivered before 10 a.m. on Wednesday, 19th January, 1927.

The Water Board do not bind themselves to accept the lowest or any Tender.

C. BURTON EDE, M. Inst. C.E.,
Engineer and Manager.

14, Portland-street, Southport,
21st December, 1926. 4300

The Madras and Southern

MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—

(1) 23 BOGIE CARRIAGE UNDERFRAMES,
14 FOUR-WHEELED UNDERFRAMES,
All Complete with WHEELS and AXLES.
(METRE GAUGE.)
(2) 64 TONS STRUCTURAL STEEL WORK for ENGINE SHED (together with Corrugated Asbestos Sheets, Glazing Bars and Wire Woven Glass).
(3) FENCING MATERIALS (i.e., Steel Standards, G.I. Eyebolts, and Straining Pillars).

Tenders are due in on 25th January, 1927, by 2 p.m. Tender forms obtainable at above address; fee One Guinea each, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender. 4413

Fuller's United Electric

WORKS, LTD.,
Chadwell Heath, Ilford, Essex.

The Receiver and Manager has realised the main portions of this undertaking, but has still FOR SALE the following DEPARTMENTS, which he is carrying on, viz.:—

(a) EBONITE DEPARTMENT, comprising Freehold Land, Buildings, Plant and Loose Tools.
(b) CARBON BLACK DEPARTMENT, comprising Freehold Land, Buildings, Plant and Offices.

Also PLOTS of VACANT LAND, amounting in all to about 22¼ acres and with frontages on Grove-road and Chadwell Heath-lane.

Particulars from MANN, JUDD, GORDON and CO., 8, Frederick's-place, E.C. 2. 4369

PUBLIC NOTICES

City of Karachi (India).

APPOINTMENT OF CHIEF OFFICER.

The Municipal Council of the City of Karachi invite APPLICATIONS for the APPOINTMENT of CHIEF OFFICER.

The Chief Officer is required on behalf of the Municipality to conduct all general correspondence, keep minutes of proceedings, supervise the accounts, collection of revenue and expenditure, exercise control over the staff and departments subordinate to him, and to perform all the administrative duties as prescribed by the Municipal Act and Rules.

Applicants must produce evidence of a good general education, must possess an intimate knowledge of municipal administration in all its branches. Preference will be given to applicants who have had experience and held responsible positions in a municipal or other similar public office.

The selected candidate will be required to furnish a medical certificate of sound health prior to his engagement.

The appointment will in the first instance be for one year on probation, and if confirmed for satisfactory work, he will be required to execute an agreement for a further period of four years, and thereafter for renewable periods of five years.

The salary of the post is Rs. 1500, rising by annual increments of Rs. 100 to Rs. 2000, plus Rs. 150 motor car allowance.

The holder of the appointment is required to subscribe to the Municipal Provident Fund, and he will be entitled to leave and pension in accordance with the Municipal Rules in force from time to time.

The salary will commence from the date of joining the appointment in Karachi, but a single first-class steamer or rail fare to Karachi will be paid.

Canvassing or the forwarding of letters of recommendation to the President or Councillors will make the applicant liable to disqualification.

Applications, stating age, qualifications, and experience, together with recent photos and with copies of recent testimonials (which will not be returned), to be sent to the President, Municipal Office, Karachi, India, not later than 1st March, 1927.

For reference to municipal leave, pension and Provident Fund rules see personally Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1, London (England).

JAMSHED N. R. MEHTA,
President, Karachi Municipality.

Karachi, 10th December, 1926. 4421

For Work Wanted Advertisements see page 98.

PUBLIC NOTICES

Sudan Government Railways

REQUIRE the SERVICES of TWO CIVIL ENGINEERS. Age 26 to 32, preferably single. Candidates should have had good experience in Surveyors and General Training as Civil Engineer, and possess A.M.I.C.E. Degree or equivalent. Those with British railway experience would have special consideration. Starting rate of pay, £E480 to £E540 per annum, according to age and qualifications (£E1 equals £1 0s. 6d. approximately). Progressive and pensionable posts if retained. Strict medical examination. Free first-class passage. Liberal leave on full pay with assisted passages.—Apply by letter, giving details of education, training and experience to ADVISORY ENGINEER, Sudan Government London Office, Wellington House, Buckingham Gate, S.W. 1, marking envelope "Civil Engineer." 4409

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED by a Leading Boiler Insurance Company, additional BOILER INSPECTORS. Applicants must be practical engineers with technical training, holding a first-class or extra first-class Board of Trade certificate, capable of making accurately dimensioned sketches of all classes of steam boilers and writing clear reports on condition. Commencing salary £260 per annum.—Address, 4422, The Engineer Office. 4422 A

WANTED, YOUNG ENGINEER, to Take Charge of Erection and Maintenance of Plant of Woodworking Machinery in South Africa. Knowledge and experience of wood-working machinery essential. Progressive opening for suitable man.—State qualifications and salary required, to Box "Z.Z. 402," c.o. Deacon's Advertising Agency, Fenchurch-avenue, E.C.3. 4423 A

DISTRICT ENGINEERS (CIVIL) REQUIRED for Railway in Brazil. Age preferably not over 30. Single. Permanent Way experience essential. Three years' contract. Starting salary (one-third in sterling) approximately equivalent to £400 p.a. and house allowance, rising to £480 on proficiency in Portuguese.—Write, giving full particulars education, training, experience, age, with copies (only) of testimonials, to Box "W. B. A.," 95, Bishopsgate, E.C. 2. 4380 A

SITUATIONS OPEN (continued)

ENGINEER REQD., Ceylon, with Good Exp. Gas and Oil Engines ess. Single, 25/29. Rupees 400 p.m. to start.—Apply, LAURIE'S, Employment Specialists, 28, Basinghall-st., E.C. 2. No preliminary fee. 4406 A

MANCHESTER ENGINEERING FIRM REQUIRE an ENGINEER-SALESMAN to act as Assistant to their London Office Manager; should have knowledge of Heat Transfer Problems and Practical Electricity. State age, experience, and salary.—Address, 4403, The Engineer Office. 4403 A

RESIDENT ENGINEER REQD., S. American Railway. Good exp. Permanent Way and Bridge Maintenance ess. Spanish an asset. Single, 25/30. £400 p.a.—Apply, LAURIE'S, Employment Specialists, 28, Basinghall-st., E.C. 2. No preliminary fee. 4405 A

WATERWORKS.—WANTED for Important Waterworks in South America, experienced CHIEF ENGINEER to Superintend Pumping, Filtration and Distribution Plant. Must have had practical experience in all branches of the above, including latest forms Mechanical and Chemical Filtration. Liberal salary to suitable applicant. Knowledge of Spanish desirable.—Write, "WATERWORKS," c/o Street's, 6, Gracechurch-street, E.C. 3. 4411 A

WANTED, DRAUGHTSMAN for Structural Steel. Age 28-30. Experience in Shops essential. Knowledge of Pipe Work or General Mechanical Work would be an advantage.—Write, Box J. 184, Willing's, 133, Moorgate, E.C. 2. P2605 A

WANTED IMMEDIATELY, First-class DRAUGHTSMAN, Design of Heavy Castings, Machinery, and Structural Work. Good experience and references essential. Applications from London area only.—Address, 4395, The Engineer Office. 4395 A

WANTED, JUNIOR DRAUGHTSMAN; Preference given one having some experience Pneumatic Tools.—Address, stating experience and salary required, 4418, The Engineer Office. 4418 A

For continuation of Small Advertisements see page 3.

Clayton-Babcock

COLD-STARTING

HEAVY OIL ENGINES

(TWO STROKE CYCLE)

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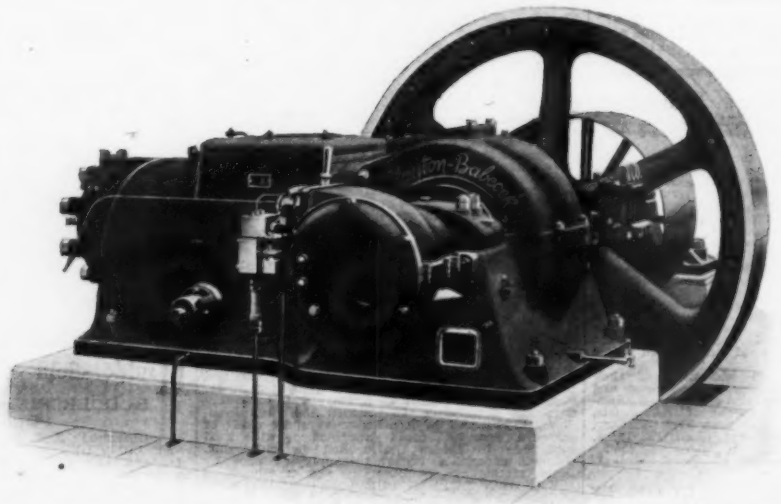

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JANUARY 7, 1927.—VOL. CLXIII.

THE ENGINEER.

A Seven-Day Journal

Southern Railway Developments.

AN extensive programme of work to be undertaken this year is announced by the Southern Railway. These new works, together with those at present being carried out, will involve an estimated expenditure of over £8,000,000. Every contract, it is hoped, will be placed with British firms. The largest item in the programme is the dock extension scheme at Southampton. On this scheme an expenditure of £3,000,000 has been authorised, and when it is completed 16,600ft. of additional quayage capable of accommodating twenty large liners, will be added to Southampton's dock facilities. A beginning with the first section of the scheme was made on Monday of this week, January 3rd, when dredging for a new deep-water channel to provide access to the new docks was commenced. The scheme involves the reclamation of an area of 18 acres, on which factories and warehouses are to be established. New loop lines are to be built at Minster Junction, near Ashford, Kent, and at Brighton, and new carriage cleaning sheds are to be erected at a cost of £160,000 at Victoria and Clapham Junction. Other works to be undertaken include the re-arrangement of Eastbourne Station and the erection of a new station at Epsom. Approval is to be sought for several widening schemes, notably of the main line between Hayward's Heath and Wivelsfield. During the year it is intended to proceed with the programme covering the building of ten express locomotives of the 4–6–0 "King Arthur" or "Lord Nelson" class, five goods engines of the 4–6–0 type, twenty passenger tank engines of the 2–6–4 "River" class, eight shunting engines of the 0–8–0 type, 70 bogie corridor coaches, 1400 12-ton open goods wagons, and 100 cattle wagons. This section of the programme will involve an expenditure of £700,000.

A New Power Station for Birmingham.

A CONTRACT, amounting to no less than £1,458,000, has been awarded to International Combustion, Ltd., by the City of Birmingham Electricity Committee. It is for the whole of the work involved in the construction of the first section of the new Hams Hall super-power station, which is one of the new capital power stations to be built under the Government's electricity scheme. The civil engineering work covers the preparation of the site, levelling, piling, mass concrete foundations, the steel-framed buildings for the switch house, the turbine house and boiler house; it also covers workmen's dwellings, reservoirs, railway sidings, locomotive sheds, and the levelling of the coal storage site. This work, together with the ash-handling plants, has been sub-contracted to the Mitchell Conveyor and Transporter Company, Ltd. Each of the main turbo-alternators will have a capacity of 30,000 kilowatts, whilst the house generators will be capable of developing 1500 kilowatts. All the switchgear, transformers, motor generators and condensing equipment will be supplied by the General Electric Company. In the boiler house five of the largest water-tube boilers so far constructed in this country are to be installed, each having an evaporative capacity of 200,000 lb. per hour. The working pressure will be 375 lb. per square inch. The boilers are to be fitted with pulverised coal firing equipment, manufactured by International Combustion, Ltd. The initial capacity of the first section of the station will be 60,000 kilowatts, but the ultimate capacity will be 210,000 kilowatts. The whole of the specifications for the scheme have been prepared by Mr. R. A. Chattock, the city electrical engineer, who was the first municipal engineer in this country to adopt pulverised fuel on a relatively large scale.

Horse-Power and Transport.

IN spite of the engineer's well-meant attempts to secure economy and efficiency in the consumption of power, there is still a very marked tendency towards excessive extravagance for particular transport purposes. In the aeronautical world, even a so-called low-powered light aeroplane, capable of carrying two people at most, can hardly do with less than 30 horse-power per person, a figure scarcely approached by the most luxurious motor car at present on the road. Larger aeroplanes—military machines, it is true—are to-day almost standardised with engines of between 400 and 500 horse-power for one or two people. Even that figure can be handsomely beaten. Elsewhere in this issue brief particulars are given of a new British aeroplane, a single-seater scout, driven by an engine of 650 horse-power. This must surely be a record in the extravagant use of power in transport. How long it will remain a record we do not know; but as still larger aeronautical engines are already in commercial production, we expect shortly to hear of the 1000 horse-power single-seater machine. This spirit of extravagance appears to be infectious. We have this week had news of the preliminary trial of a Napier-Campbell racing motor car driven by a 450 horse-power engine of the well-known Napier "Lion" design. Under apparently somewhat unfavourable circumstances, the speed attained is said to have been 133 miles an hour. A steam locomotive in the light of such figures appears a most modest contrivance. It is endowed with little more than one to two horse-power per person it transports, and for the most of its time runs at very much less than that figure. Even a modern suburban electric train is equipped with not more than about 4 horse-power per passenger. Ocean liners are higher up the scale, but even the Mauretania can do with 30 horse-power per person carried, the same amount as the "low-powered" aeroplane.

German Aviation.

FOLLOWING upon the fusion of the German air companies into one concern known as the Luft Hansa, the air services in Germany were completely reorganised during the past year. It is not yet known how much goods traffic was dealt with by aeroplanes, but it is stated that about 40,000 passengers were carried. The services are to be extended considerably during the present year by the creation of additional home lines, which will permit the international lines to be accelerated by reducing the number of landing stages, the idea being to make the home lines feed the widely separated international airway stations. Several new international airways are to be opened between Germany and Austria and Czecho-Slovakia, and a line from Dantzig to Kalmar will be connected up with Stockholm. There will also be a service of seaplanes which will follow the waterway between Cologne and Rotterdam by way of Duisburg and Ruhrort. The Berlin–Amsterdam–London line will be run by the Luft Hansa, and the London–Cologne service will be operated by Imperial Airways. Munich is becoming a big air centre, and from that town a service will be organised to Milan, and eventually to Rome, and another will go by way of Basle and Marseilles to Barcelona and Madrid, seaplanes being employed over the Mediterranean course. In summer the services will be continued from Stettin to Oslo, and the Berlin–Moscow line will be connected up with Finland. The Luft Hansa is not only carrying out a particularly elaborate flying programme, but it controls practically the whole of the aircraft industry, since all the machines are built to its specifications, comfort and convenience, as well as safety, being insisted upon. The company is leaving nothing undone to make its air services the recognised medium for fast passenger traffic.

British Oil Tanker Construction.

A POINT of interest which emerges from a perusal of the shipbuilding returns of the year is the important programme of oil tanker construction which is being undertaken by our principal oil companies and shipping concerns interested in the transport of oil fuel. In to-day's articles dealing with the building of motor ships and steamships reference is made to some tankers of outstanding interest, but they are only a few of many vessels built during the year. Important additions of tonnage were made to the fleets of the British Tanker Company, Ltd., the Anglo-American Oil Company, Ltd., and the Anglo-Saxon Petroleum Company, Ltd., to name only three prominent undertakings. It is computed that within the last three months no less than fifty such vessels, most of them motor tankers, have been ordered. Since 1914 the total world tonnage of oil tank ships has increased four times and now approaches six million tons. Owing to British enterprise, the tonnage of British-owned ships is over two million tons, and only a little less than that owned by American undertakings. This year many other tank vessels will be launched and completed.

Mr. A. J. Campbell.

IT is announced that at the end of the year 1926 Mr. A. J. Campbell resigned his appointment as general manager of the Dalmuir shipyard of William Beardmore and Co., Ltd., and that Mr. Alexander Galbraith has been appointed to the position which was thus made vacant. Mr. Campbell was appointed shipyard manager at Dalmuir on September 1st, 1912, and has thus been in the service of the company for over fourteen years. We learn that he will not sever his connection with Messrs. Beardmore, who will thus be able to retain the benefit of his long and valuable experience in the shipbuilding industry. Some notable vessels, both for the Navy and for the mercantile marine, have been built at Dalmuir under Mr. Campbell's direction. Outstanding among the former we may recall the battleships Benbow and Ramillies and the aircraft carrier Argus, along with a large number of light cruisers, destroyers and submarines of the war period. An interesting North Atlantic liner was the Empress of France, built for Canadian Pacific Steamships, Ltd.; while noteworthy ships of recent years include the Largs Bay and the Esperance Bay of the Australian Dominion Line, and the three Lloyd-Sabaudo liners, the Conte Rosso, the Conte Verde, and the Conte Biancamano. Recently Mr. Campbell has been closely identified with the work of the Shipbuilding Employers' Federation, and he is a prominent member of its central board. In October last he was elected President of the Institution of Engineers and Shipbuilders in Scotland.

An Eighteenth Century Scientific Discourse.

ON Tuesday night, Professor E. N. de C. Andrade delivered an interesting lecture in a novel setting before the Physical and Optical Societies in connection with the exhibition organised by these two bodies at the Imperial College, South Kensington. Dressed in the costume of the early eighteenth century, Professor Andrade impersonated in style and speech Francis Hauksbee, an early student of electricity. Hauksbee was a member of the Royal Society about the year 1705, when Sir Isaac Newton was the president. In his lecture Professor Andrade performed various experiments, all of which are known to have been carried out by Hauksbee. He employed an air pump, a treasured possession of the Royal Society, which Hauksbee himself had made and which, although over two hundred years old, was made to work perfectly. Professor Andrade's lecture imitated the conditions of a discourse in Hauksbee's time, even to the extent of the illumination of the lecture theatre by means of candles, which, when required, were re-lit with flint, steel and tinder.

The First Launch of the Year.

To the firm of Cammell Laird and Co., Ltd., of Birkenhead, belongs, we believe, the honour of having launched the first large ship of 1927. That vessel was the 510ft., 14,000 gross tons Blue Star liner Arandora, which successfully took the water on the morning of Tuesday, January 4th, at the firm's Birkenhead yard. The Arandora is the third geared turbine passenger and cargo steamer to be built at Birkenhead for the Blue Star Line. The first ship was the Almeda, now on her maiden voyage to South America, which was fully described and illustrated in last week's issue. The Andalusia, the second ship to be launched, is now being fitted out.

Naval Construction in 1926.

THE volume of naval shipping under construction in 1926 was greater than that of any previous year since the Washington Conference, though being made up almost entirely of cruisers and smaller craft, the aggregate tonnage seems comparatively small. With the launch of the Nelson and the Rodney in the latter part of 1925, no capital ship was left on the ways in any country, nor may any further units of that type be laid down before 1931. The influence of the Washington Treaty is revealed by the fact that no ship of war exceeding 10,000 tons is now being built at home or abroad. Of vessels completing afloat only six are above this displacement. It is fairly evident, however, that the battleship "holiday" will not be prolonged beyond the date specified by the Treaty. Speaking at the launch of the Rodney, Rear-Admiral Sir A. Chatfield, Third Sea Lord, said that naval men did not believe this battleship would be the last of her line. Rather did they regard her as the first of a new series, and they cherished the hope that many other battleships of her class would be built in the future. Foreign naval experts are apparently of the same mind, for there are indications that both in the United States and Japan tentative plans are being drafted for the "replace" battleships which, in accordance with the Treaty, may be laid down four years hence. For the present, however, the development of those non-capital types which are not subject to numerical limitation is receiving special attention. In the past year twenty-four cruisers of the 10,000-ton class were being built or fitted out by the five leading naval Powers, and in the course of this year at least twelve further ships of the same class are to be begun. The output of destroyers and submarines continues to be large, thanks mainly to the efforts of France and Japan. Dimensions show a steady increase. The latest French flotilla leaders approach 2700 tons and the new destroyers 1500 tons, while the projected Japanese destroyers are to displace 1800 tons. Submarines larger than the British X. 1 are building in the United States and France, and possibly in Japan also. Apart from increased seaworthiness and endurance, the advantages of such inflated displacements are not very obvious, while the heavy cost which this policy involves is a serious drawback. So far as British requirements are concerned, numerous destroyers of medium tonnage would be preferable to a reduced number of larger craft.

British Empire.

The new battleships Nelson and Rodney, now fitting out on the Tyne and the Mersey respectively, are expected to be ready for their trials before the summer. As they have already been described in some detail in our columns—see THE ENGINEER, August 28th, 1925, and September 11th, 1925—only a few additional notes are called for. The design, as we have previously pointed out, is revolutionary. In the calibre and distribution of the main armament, the mounting of the secondary battery, the method of armour protection, the lay-out of machinery, and the arrangement of top hamper, they differ radically from all preceding capital ships. No particulars of the machinery have been disclosed as yet, and the unofficial figures of armour protection which have been published must be accepted with reserve. In view of their epoch-making design, it is to be hoped that an authoritative description of these ships will be released in the not-too-distant future. In the following table they are compared with the best battleships of the United States and Japan :—

	H.M.S. Nelson.	U.S. Colorado.	I.J.N. Mutsu.
Length on water line, feet	702	600	660
Breadth, feet	106	97·3	95
Mean draught, feet ..	30	30¼	29
Displacement ("standard"), tons	35,000	—	—
Displacement, full load, tons	38,500 (?)	33,590	34,500
Speed, knots	23 (?)	21	23
Belt armour, inches ..	14	16	13
Armament	Nine 16in., twelve 6in., ten 4in. A.A.	Eight 16in., twelve 5in., eight 5in. A.A.	Eight 16in., twenty 5·5in. four 3in. A.A.

The foregoing comparison makes it clear that the "Nelsons" are, by a considerable margin, the most powerful battleships in the world, and since no other capital ships are likely to be completed before the end of 1933 they will retain their pre-eminence for at least seven years.

The five cruisers of the "Kent" class begun under the Navy Estimates for 1924–25 were all launched during the past year, the name ship at Chatham on March 16th, the Suffolk at Portsmouth on February 16th, the Cornwall at Devonport on March 11th, the Cumberland at Barrow on March 16th, and the Berwick at Govan on March 30th. They are understood to be uniform in design, the late Director of Naval Construction, Sir E. T. D'Eyncourt, having been responsible for the plans. Beyond the fact that their "standard" displacement is 10,000 tons and their main armament consists of eight 8in. guns, few details of these ships have been released. When the Cumberland was launched the Third Sea Lord made some frank comments on the strange method of determining warship displacement which the Washington Conference saw fit to adopt. "The Cumberland is, as you know, of 10,000 tons standard displacement," he said. "The only peculiarity about that measurement is that she is not 10,000 tons. I am not letting you into any secrets when I say she has a larger displacement, because the wise men of Washington decided that in the displacement of a ship the fuel carried should not be included, and so the Cumberland is somewhat larger, although I am not allowed to tell you by how many more tons. The naval architect is very much in the position of Shylock in 'The Merchant of Venice.' If he makes the ship one ounce heavier than 10,000 tons, he stands to lose the reputation of his country and its international integrity; whereas, if he makes it one ounce less, the sailor says: 'You have given up some small measure of fighting power.' He is, indeed, between the devil and the deep sea." As the new cruisers were designed primarily for commerce protection, a duty which necessitates exceptional steaming endurance, it is certain that their fuel capacity will be large. The "Raleighs," which were also built for ocean patrol, can stow a maximum of 2150 tons of oil. It seems probable, therefore, that with a full supply of fuel and feed water on board the Kent and her sisters will displace something over 12,000 tons. The hull, which is flush-decked and noticeably high in freeboard, is fitted with bulges. No side armour is carried, but the vitals are protected by a 4in. vaulted deck. The eight guns are paired in turrets symmetrically disposed at bow and stern. Abaft the bridge rises a large tower in which are situated the gunnery control positions, a light pole mast being substituted for the usual tripod. As the speed of these ships is unknown, it is impossible to compare them with contemporary foreign cruisers of the same tonnage.

Two identical ships, Australia and Canberra, were laid down for the Australian Government in 1925 by John Brown and Co., at Clydebank, and both will be launched early this year. In February last the London was begun at Portsmouth as the name ship of a group of four cruisers designed by Sir W. J. Berry, the present Director of Naval Construction. The Devonshire is on the stocks at Devonport, the Shropshire at the Beardmore yard in Dalmuir, and the Sussex at the Hawthorn-Leslie establishment at Hebburn-on-Tyne. All four should go afloat in the present year. They are of the same displacement as the "Kent" class, to which they will probably conform in general design. Whatever its shortcomings in the matter of protection, the new type of cruiser represents a great advance in armament and speed. In range and destructive power the new 8in. 250-pounder B.L. is, of course, immeasurably superior to the 6in. 100-pounder, which has been for so long the standard armament of our cruisers. Three further cruisers are to be laid down during the current fiscal year, one of which will be built by Palmers, of Jarrow, the second, with its propelling machinery, has been ordered from the Fairfield Shipbuilding and Engineering Company, Ltd., and the third is to be built at Portsmouth Dockyard, the main and auxiliary machinery for this vessel being supplied by Cammell, Laird and Co., Ltd. Two of these vessels will be of 10,000 tons and the other of 8000 tons. By the end of March, therefore, fourteen cruisers, including the Australian pair, will be building or completing in this country. For the financial year 1927–28 one cruiser of 10,000 and two of 8000 tons are provided.

The cruiser minelayer Adventure, which was begun at Devonport late in 1922, was commissioned for trials last November. In our judgment this vessel should be rated simply as a minelayer, as she is too slow and much too feebly armed to be profitably employed as a cruiser. With her speed of 27·75 knots and her four 4·7in. guns she could neither escape pursuit by a modern cruiser nor put up a good fight when brought to bay. We are not at all convinced of the wisdom of building such a nondescript vessel, particularly at a time like the present, when every pound spent on naval defence ought to be laid out to the best advantage. Except that she apparently carries a large cargo of mines, the completion of the Adventure adds little to the strength of the fleet. The abnormal radius of action conferred by the auxiliary Diesel-electric drive with which she is equipped is certainly a strategic asset, but its value is partly nullified by the low power of the main engines. The Adventure is 520ft. long overall, the breadth over the bulges is 59ft., and the normal displacement 7260 tons. It is expected that she will eventually receive a more powerful armament, thus remedying a serious defect in the original design.

The first two destroyers built since the war were launched last year, the Ambuscade by Yarrow, on January 15th, and the Amazon by Thornycroft, on January 27th. They are developments of the "Admiralty W" class, from which, however, they differ in certain important features. Their leading particulars are tabulated below, together with those of the "W" boats :—

	Length. ft.	Breadth. ft.	Draught. ft. in.	Displacement. tons.	Speed knots.
Amazon ..	311½ ..	31½ ..	9 1 ..	1330 ..	37
Ambuscade	307 ..	31 ..	8 3 ..	1210 ..	37
"W" class	300 ..	29½ ..	10 10 ..	1325 ..	34

The new boats, it will be noticed, are broader and shallower than the "W's," and the speed has been increased by three knots. The freeboard is higher and living quarters and ventilation have been much improved. The armament remains the same, viz., four 4·7in., two 2-pounder pom-poms, and five machine guns, with six 21in. torpedo tubes on triple mountings.

The submarine Oberon, laid down at Chatham in March, 1924, as the O. 1, was launched on September 24th in a practically completed state. She is the first unit of the new "Oversea" type of patrol submarine, the design of which is based on war experience. The displacement is 1480 tons on the surface and 1750 tons submerged. Speed and armament have not been disclosed, but it is known that the guns are mounted on a level with the conning tower, as in the "L" class. Two boats of the same class, built for the Australian Government by Vickers at Barrow, were launched, the Oxley on June 30th and the Otway on September 7th. Of the six "O" type submarines provided for in the current Estimates, Vickers are to build three and Beardmores two, while the sixth boat is to be laid down at Chatham. These are the first submarine contracts—apart from the Australian boats—which have been awarded to private industry since 1918. The submarine cruiser X. 1, having carried out prolonged trials and undergone certain modifications, is at last ready for service, and will shortly proceed to the Mediterranean. It is now permissible to say that she is armed with four 5·2in. guns—a new calibre—and six torpedo tubes. The surface speed is not above 22 knots. In view of her great length, 350ft., and the fact that when in diving trim she displaces 3600 tons, she requires very careful handling under water. The initial cost of £941,794 has been increased to well over a million by subsequent alterations.

Work proceeded during the year on the Glorious and Courageous, which are being rebuilt as aircraft carriers at Devonport. Owing to the limited funds available progress is slow, and they are not expected to be ready for sea before 1928. As reconstructed they will resemble the Furious, except that each will have a single funnel on the extreme starboard side. A large submarine depôt ship was ordered from Vickers in September. The chief point of interest about this vessel is that she will be propelled by twin-screw double-acting Diesel engines, to be constructed by Vickers under the M.A.N. licence. On November 16th Swan, Hunter and Wigham Richardson, Ltd., of Wallsend-on-Tyne, received an Admiralty contract for the construction of a floating dock for use at the new Singapore base. This dock is to be 850ft. long and 170ft. wide, with a lifting capacity of 50,000 tons. It is estimated to cost £1,200,000.

United States.

The amount of American naval tonnage laid down last year was very small, being limited to two cruisers and two submarines. Although eight cruisers were authorised in 1925, the first vessel was not begun till October 27th last. She is the Pensacola, which is building at New York Navy Yard. No news has been received of the laying down of the second ship, Salt Lake City, but she is believed to be under construction by Cramps, of Philadelphia. Three further vessels are due for commencement this year. Particulars of the design, as officially communicated, are as follows: —Length overall, 585ft.; breadth, 66ft.; mean draught, 19ft.; standard displacement, 10,000 tons; speed, 33 knots. Guns: ten 8in. in two triple and two double turrets, six 5in. A.A. pieces. Armour protection is restricted to a thin deck and some plating over the magazines. It is reported, but not yet confirmed, that the boilers will deliver steam at a pressure of 700 lb. This very high pressure has made it necessary to re-design all steam pipes, glands, valves, and other parts of the engine plant. Two submarines, V. 5 and V. 6, were begun on June 1st at Portsmouth (N.H.) and Mare Island, respectively. Their surface displacement is reported to be over 3000 tons, in which case they will be the largest submarines designed for any navy. The official estimate of cost is £1,274,000 per boat. The V. 4, which is to be launched early this year, is a submersible minelayer of 2890 tons—110 tons more than the British X. 1—with a surface speed of 17 knots. She is armed with one 6in. gun, four 21in. torpedo tubes, and sixty mines.

Three old battleships, Texas, Arkansas, and Florida, were extensively reconstructed during the year, involving the replacement of their coal-burning boilers by those of oil-fired type, the fitting of bulges, and the working in of additional armour plate over the magazine and machinery spaces. In each vessel one of the two funnels has been suppressed, all the uptakes now leading into a single casing. The Texas has had her lattice masts replaced by tripods, which were found to provide a steadier platform for the fire control instruments. The Arkansas and the Florida now have a lattice foremast and a tripod mainmast. Each ship has further been equipped with an aeroplane catapult and twin derricks for hoisting machines inboard. Owing to the change from coal to oil firing, steaming efficiency and radius of action have been sensibly increased. The New York, Wyoming, and Utah are now undergoing reconstruction on similar lines. The huge aircraft carriers Lexington and Saratoga, 33,000 tons and 34·5 knots speed, will be commissioned in the first half of this year. A Bill providing for the

construction of ten additional cruisers of the 10,000-ton class was presented to Congress on December 18th.

Japan.

Financial stringency continues to retard naval construction in Japan. Of the eight cruisers authorised in 1922 only two have been completed so far, and four have yet to be launched. The largest ships that went afloat during the year were the cruisers Aoba, at Nagasaki on September 24th, and Kinugasa, at Kobe on October 24th, both having been on the stocks for thirty months. They are sister ships of 7100 tons—probably the "standard" displacement—with a length of 580ft. overall, a breadth of 50ft. 9in. and a mean draught of 14ft. 9in.; geared turbine machinery of 100,000 shaft horse-power for a speed of 33 knots; and a main armament of six 7·5in. guns paired in turrets, two forward and one aft. In tonnage and other dimensions they are identical with the Kako and Furutaka, illustrated in one of our Supplements to-day, which were completed last year. In the latter ships, however, the six big guns are on single mountings and equally distributed between bow and stern. This arrangement, together with the curious grouping of the funnels and the "lighthouse" foremast, gives them a distinctly odd appearance. Each ship carries two aeroplanes in an enclosed hangar abaft the after funnel, and a catapult. In proportion to tonnage no other men-of-war now afloat are equal to these ships in fighting power, on paper at least. It remains to be seen whether they are successful in service. Judging from their appearance they should be extremely lively in a seaway, for the amount of top hamper they carry seems to be excessive.

Four cruisers of the 10,000 type, Nachi, Myoko, Ashigara, and Haguro, which were begun in 1924–25, are expected to take the water this year. The Myoko would have been launched at an earlier date, but in December, 1925, she was seriously damaged by the collapse of two cranes, and the amidships section of the vessel has had to be practically rebuilt. Few authentic details of the design are known. It provides for a main armament of nine 8in. guns in triple turrets, a speed of 33 knots, and some vertical armour protection. The large aircraft carriers Akagi and Kaga, 26,900 tons and 27,000 tons respectively, which were originally planned as capital ships, are due to be commissioned this year. At the beginning of 1926 twelve destroyers were under construction, seven being of the new 1800-ton class and five of 1400 tons. Several of them have since been launched, but the exact dates are uncertain. Twelve further destroyers remain to be built under the 1923 programme. The larger boats were to have been armed with 6in. guns, but for reasons of economy a 4·7in. armament has been substituted. Submarine construction in hand during the year included one boat of 770 tons, two of 998 tons, three of 1000 tons, four of 1500 tons, and three of 1970 tons. Thirteen others had been authorised, and some of these are probably now on the stocks. As will be seen from a view we give in one of our Supplements to-day, the latest Japanese submarines are very large and powerful craft. It is understood that the newest vessels represent a further advance in displacement, and that at least four are minelayers. A new programme now before the Imperial Diet provides for the following further construction:—Four cruisers of the 10,000-ton class, fifteen destroyers, four submarines, three gunboats, an aircraft carrier, and a minelayer. The cost is estimated at £26,100,000.

France.

The French Navy was heavily reinforced during the year by the completion of cruisers, torpedo craft, and submarines. The largest vessels to be commissioned were the cruisers Duguay-Trouin—see Supplement—Lamotte-Picquet, and Primauguet, which were laid down in 1922–23. Their completion was delayed by minor changes in structure and machinery. The Duguay-Trouin, built at Brest dockyard, began her trials in May. The following are the leading particulars of the class:—Length overall, 604ft.; breadth, 56½ft.; draught, 17½ft.; displacement, 7880 tons; machinery designed for 100,000 shaft horse-power and 34 knots. Protection is very scanty, and is believed to be limited to light deck plating and splinter-proof turrets and conning tower. The main armament is eight 6·1in., 55-calibre guns paired in turrets, with four 2·9in. A.A. guns and twelve above-water torpedo tubes. The propelling machinery of the Duguay-Trouin, which was built at the Ateliers et Chantiers de la Loire, comprises four independent sets of Parsons turbines, each operating a propeller shaft through double helical hearing of the single reduction type. Steam is taken from eight Guyot small-tube oil-fired boilers at a pressure of 256 lb. The heating surface of each boiler is 11,840 square feet. The steam trials included a six-hour run at full power, a thirty-hour endurance run at a speed of 30 knots, and a fuel consumption trial lasting eight hours at a speed of 15 knots. The principal results of the full-power trials are tabulated below:—

	Duguay-Trouin.	Lamotte-Picquet.	Primauguet.
Speed on measured mile, knots	33·60	33·04	33·066
Mean power developed, shaft horse-power	116,235	115,100	116,849
Mean fuel consumption per hour, kilogrammes	46,367	49,000	50,584

Although the speed in each case was below the designed maximum, the trials were considered satisfactory, all parts of the machinery functioning well and the consumption of fuel being moderate. It is believed that with some modification of the propellers the designed speed can be attained without difficulty. Our illustration of the Duguay-Trouin shows the handsome appearance of the first high-speed cruisers which have been built in France for many years. Two ships of the 10,000-ton class are now completing afloat, the Duquesne having been launched at Brest on December 17th, 1925, and the Tourville at Lorient on August 24th last. A third ship, the Suffren, is on the stocks at Brest. Principal details of the class:—Length overall, 624ft.; breadth, 63ft.; draught, 20ft.; standard displacement, 10,000 tons. The machinery will consist of four sets of geared turbines and nine Guyot oil-burning boilers, with a designed output of 130,000 shaft horse-power for 33 knots. Armament: eight 8in. guns, eight 2·9in. A.A. pieces, six torpedo tubes. A fourth unit of the same class is to be laid down this year, but will differ from the others in having certain boilers adapted for mixed firing, in order to make her less dependent on oversea oil supplies.

The six powerful flotilla leaders of the "Chacal" class, of which the last were commissioned during the year, have been fully described in our columns, July 23rd, 1926. The displacement is 2362 tons and the designed speed 35·5 knots. This was exceeded on trial in nearly every case, the Tigre, for example, averaging 36·93 knots for one hour and 35·7 knots for eight hours. Three still heavier leaders, known as the "Guépard" class, were begun in September, two at Lorient and the third at a private yard. These are vessels of 2650 tons and 36 knots, armed with five 5·5in. guns, as against the 5·1in. weapons mounted in the preceding group. All the twelve destroyers of the "Simoun" class—1430 tons, 33 knots, four 5·1in. guns, six tubes—are now in service after undergoing successful trials. The majority proved able to exceed the specified speed. Six destroyers of the "Adroit" class have been launched, the Palme and Alcyon in June last, the Adroit in July, the Fortuné and Mars in August, and the Railleuse in September. They are 35 tons heavier than the "Simouns" and will mount 5·5in. guns, but otherwise are very similar in design. Four additional boats of this class were begun last year, to be named Basque, Bordelais, Boulonnais, and Brestois.

A large amount of submarine tonnage is in hand. The Phoque was launched on March 16th and the Caiman in June, these being the last of the nine boats of the "Requin" class, authorised in 1922–23. They have a surface displacement of 1130 tons, a speed of 16 knots, and a sea endurance of thirty days. The armament is one 3·9in. gun and ten tubes. They are said to be the most efficient submarines so far built in France, and to possess excellent sea-going qualities. All the completed boats have made long independent cruises without the slighest mishap. Nine larger submarines, "Redoubtable" class, are now under construction, the surface displacement being 1550 tons and the speed 18 knots. A submersible cruiser of no less than 3000 tons is about to be laid down at Cherbourg. She will have a surface speed of 18 knots and is to carry 5·5in. guns. Twelve medium submarines of the "Ariane" class, 600 tons and 14 knots, have been launched and six more are building. The residue of the French shipbuilding project, which is due for completion in 1931, is made up of the following:—Three cruisers, twelve flotilla leaders, fourteen destroyers, and twenty-four submarines. Provision has already been made for laying down certain of these vessels in the present year.

Italy.

The only large ships under construction for the Italian Navy are the cruisers Trieste and Trento, the first of which was launched on October 24th at Stabilimento Tecnico, Trieste, and the second will be launched early this year. They have a length of 642ft. overall, a breadth of 67½ft., and a standard displacement of 10,000 tons. The machinery is designed for 150,000 shaft horse-power and 34·5 knots, and the armament consists of eight 8in. guns and sixteen 4in. A.A. weapons. Three further cruisers of this class are projected. Eight destroyers were completed during the year, and eight more are on the stocks or completing afloat. They average 1200 tons and 35 knots, and are armed with four 4·7in. guns on twin mountings and six torpedo tubes. Of the twelve submarines now building, four are of 1300 tons surface displacement and 18½ knots speed, four of 805 and four of 780 tons, the last two groups having a uniform speed of 17½ knots. A new building programme is under consideration, but has not yet been announced.

Minor Navies.

The Miguel de Cervantes, a third cruiser of the "Principe Alfonso" class, was begun for the Spanish Navy at Ferrol in the autumn. The design of this class was prepared by the late Sir Philip Watts and has many points of resemblance to that of our "E" type cruisers. The displacement is 7850 tons and the speed 33 knots. Three further flotilla leaders of the "Churruca" type were laid down at Cartagena during the year, making six in all, and three more are projected. In dimensions, speed, and armament they are very similar to British vessels of the "Scott" class. The Churruca did extremely well on her trials last June, averaging 37·64 knots on an eight-hour run and reaching a maximum of 39·76 knots. Several submarines of 915 tons are being built at Cartagena.

In Sweden the destroyers Ehrenskold and Nordenskjöld were launched during the summer. Plans and details of these boats have already appeared in THE ENGINEER, June 19th, 1925. Displacement, 974 tons; speed, 35 knots; three 4·7in. guns and six tubes.

Six destroyers of a very powerful type are under construction in Holland for the Netherlands Navy. The design was prepared by Yarrow and Co., Ltd., in competition with other firms in this country, France, Germany, and the United States. Particulars:—Length overall, 322ft.; breadth, 31½ft.; draught, 9¾ft., displacement, 1620 tons. Machinery, Parsons geared turbines and Yarrow superheated boilers, designed for 31,000 shaft horse-power and 34 knots in loaded condition (36 knots when light). Armament, four 4·7in. guns, two 3in. A.A., six tubes. The equipment includes a seaplane and minelaying gear.

Among the minor naval Powers, Poland and Latvia have had submarines constructed in France, and two submarines for Peru have recently been delivered by an American firm. The large naval orders from Argentine, Chile, and Brazil reported to be impending last year have not yet materialised.

Locomotives of 1926.

THE three principal events in the field of locomotive engineering in Great Britain during 1926 were the appearance on the Southern Railway of Mr. Maunsell's new four-cylinder locomotive Lord Nelson, the completion of the Ljungstrom locomotive which Beyer, Peacock and Co., Ltd., have constructed, and the tests of the all-British steam turbine locomotive designed by Sir Hugh Reid and Mr. MacLeod and built by the North British Locomotive Company, Ltd.

The Lord Nelson.

Mr. Maunsell's engine—see one of to-day's Supplements—has received so much attention in our pages quite recently that it is unnecessary to say much about it here. It was described in our issues of October 15th, 1926, and November 19th, 1926, and letters about it appeared in our issues of October 15th and November 19th, 1926. The feature of it which gives it its great interest is the arrangement of the cranks and the consequences which ensue. Taken in sequence the angles between the crank pins are 90 deg., 135 deg., 90 deg. and 45 deg. If this arrangement be drawn and the lines be extended to a circle described about the centre, it is obvious that there will be eight equally distributed points on the circle. Each point corresponds to a blast from one end or the other of one of the cylinders. Hence in place of the four blasts which the ordinary two-cylinder engine gives, or the six lesser blast, equally distributed, which the three-cylinder high-pressure engine gives, or the four heavy blasts which the four-cylinder engine with all cranks at 90 deg. gives, we have eight blasts, each from a relatively small cylinder, 16½in. in this case. The magnitude of the result achieved was hardly anticipated. Mr. Maunsell had foreseen the advantages of a regular blast, but he was hardly prepared for the surprising difference which it makes to the steaming of the boiler. The blast was so effective that it was found necessary to soften it by enlarging the blast-pipe orifice on three occasions, and we understand that even now, with the orifice abnormally large, the boiler gives more steam than enough.

In another respect Mr. Maunsell has departed from common practice. He balances far less of the reciprocating masses than is usual, and by so doing reduces the hammer blow to quite a negligible amount. This interesting point was fully discussed with diagrams in THE ENGINEER of November 19th, to which we refer our readers for further particulars.

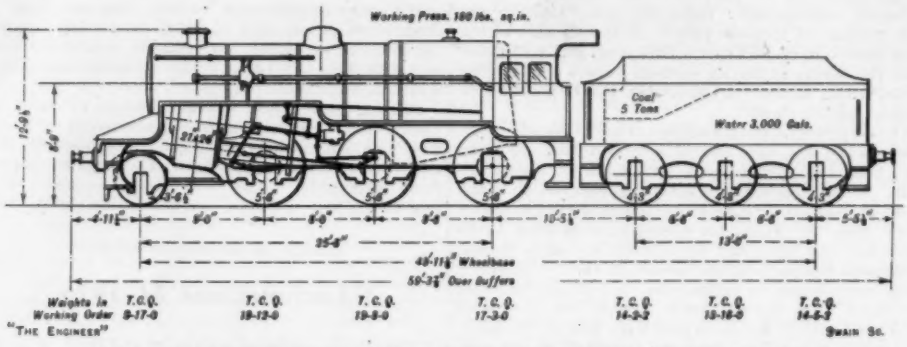
The Ljungstrom Turbine Locomotive.

The Ljungstrom steam turbine locomotive was constructed by Beyer, Peacock and Co., Ltd., at Manchester, to the design of the original inventors and manufacturer, but considerably modified by British locomotive practice. From the illustration of it which we give in one of our Supplements to-day, it will be seen that in many respects it has a British appearance. It was completed several months ago, and after preliminary trials was lent to the London, Midland and Scottish Railway, which will give it service tests between London, Manchester and Glasgow on express trains.

The type is already familiar to our readers, but it may be of some service to recall that, broadly, it consists of two vehicles, one carrying the boiler and its accessories and the other the turbine and the condenser. The turbine is placed with its axis transverse to the centre line of the engine, and drives the leading pair of wheels on the motive vehicle through double helical reduction gearing. Two other axles are coupled to the driving axle in the usual way. A quill-type axle is used for the drive, and reversal is effected by means of an idle shaft and gears. The turbine itself is of the

axial flow type, and is designed to develop 2000 horse-power at 10,000 revolutions per minute, equivalent to an engine speed of 70 miles per hour.

The condenser, of the Ljungstrom air-cooled type with auxiliary water surface condenser, comprises 2500 copper tube elements, arranged vertically on each side. Air is drawn between these tubes by four turbine-driven fans. A pump, driven from the fan shaft circulates the water for the auxiliary condenser. This water is used as the feed for the boiler. The boiler, it will be seen from the illustration, is of the ordinary Belpaire locomotive type, but a Ljungstrom air heater is fixed in the smoke-box and supplies heated air to a closed ashpan. Since there is no blast, a turbine-driven fan is used to produce the draught necessary for combustion. It can be controlled from the footplate. Even the feed is effected by turbine-driven pumps, which deliver through a tubular feed heater.



L. M. AND S. RAILWAY—MIXED TRAFFIC ENGINE, PROFILE AND WEIGHT DIAGRAM

The Reid-MacLeod Turbine Locomotive.

This engine was exhibited at the Wembley Exhibition of 1924, and was dealt with in our columns at the time. As we propose to deal with it fully at an early date, it is unnecessary to say much about it now. Its characteristic is that it is provided with two power bogies, one driven by the high-pressure and the other by the low-pressure turbine. The connection between the rotors and the axles takes place through helical reducing gear and bevel wheels, no coupling rods being used.

Apart from the new Southern Railway engine, there is not much new to put on record with regard to companies' locomotives, but it may be convenient to outline their activities in order.

Southern Railway.

Besides the Lord Nelson, the Eastleigh Works also built during the year twelve of a batch of fourteen "King Arthur" class 4–6–0 type engines for working Victoria and Brighton trains. These engines are fitted, owing to the shortness of the run, with standard six-wheeled tenders of 3500 gallons capacity, instead of large bogie tenders.

For working trains between Charing Cross and Dover or Hastings on the Eastern Section fifteen 4–4–0 type passenger engines were delivered by the North British Locomotive Company, Glasgow. In general design the engines are duplicates of those introduced in 1914, but numerous improvements have been made by Mr. Maunsell in various details. The boiler pressure has been increased from 160 lb. to 180 lb. per square inch, and the diameter of the cylinders reduced from 20½in. to 19½in. The Stephenson valve gear has been entirely remodelled, the travel in full gear being increased to 5¾in. and the lap to 1 1/16 in. The cab is of new design, having an extended roof and side windows. A standard six-wheeled tender is provided.

Work in progress at the various shops includes the building of fifteen 4–6–0 type goods engines with 5ft. 7in. wheels at Eastleigh, these engines having the boiler, cylinders, motion, bogie, &c., standard with the "King Arthur" class engines; and ten 2–6–4 type passenger tank engines at Brighton, these having the boiler cylinders, motion, &c., interchangeable with the standard 2–6–0 goods engines. In addition, further engines of the 4–4–0 passenger type are to be rebuilt as superheaters at Ashford.

The London, Midland and Scottish.

The new locomotive work for this company taken in hand during 1926 is as follows:—50 4–4–0 standard superheater compound passenger engines; 200 0–6–0 standard freight tender engines; 150 0–6–0 standard shunting tank engines; 100 2–6–0 mixed traffic engines; three 2–6–0—0–6–2 Garratt engines. Of these, the 2–6–0 mixed traffic engines are of a new design.

The fifty superheater compound passenger engines are being built by the Vulcan Foundry, Ltd., but none of them are yet in service. They will be numbered 900 to 934 inclusive and 1185 to 1199 inclusive. Fifteen are intended for service on the Western "B" Division, or former Lancashire and Yorkshire Railway, ten for the Midland Division, and 25 for the Northern Division. They have three cylinders, one high-pressure, 19in. diameter, and two low-pressure, 21in. diameter. As is well known, the type is a development of the three-cylinder superheater compounds of the former Midland Railway Company, and, in common with the other engines of this type built since the formation of the London, Midland and Scottish Railway, they are fitted with 6ft. 9in. coupled wheels instead of the original 7ft. wheels. The chimney and dome have also been lowered in order to pass the Northern Division loading gauge. The heating surface, &c., of these engines is given below. The tractive effort is 22,649 lb., calculated on the 80 per cent. boiler pressure on the low-pressure cylinders.

	Square feet.
Fire-box	147·25
Tubes	1169·50
Total	1316·75
Superheater	200·75
Grate area	28·4

Early in the year five engines of this type, the balance of an outstanding order, were turned out of the Horwich works for service on the Western "A" Division, or former London and North-Western Railway.

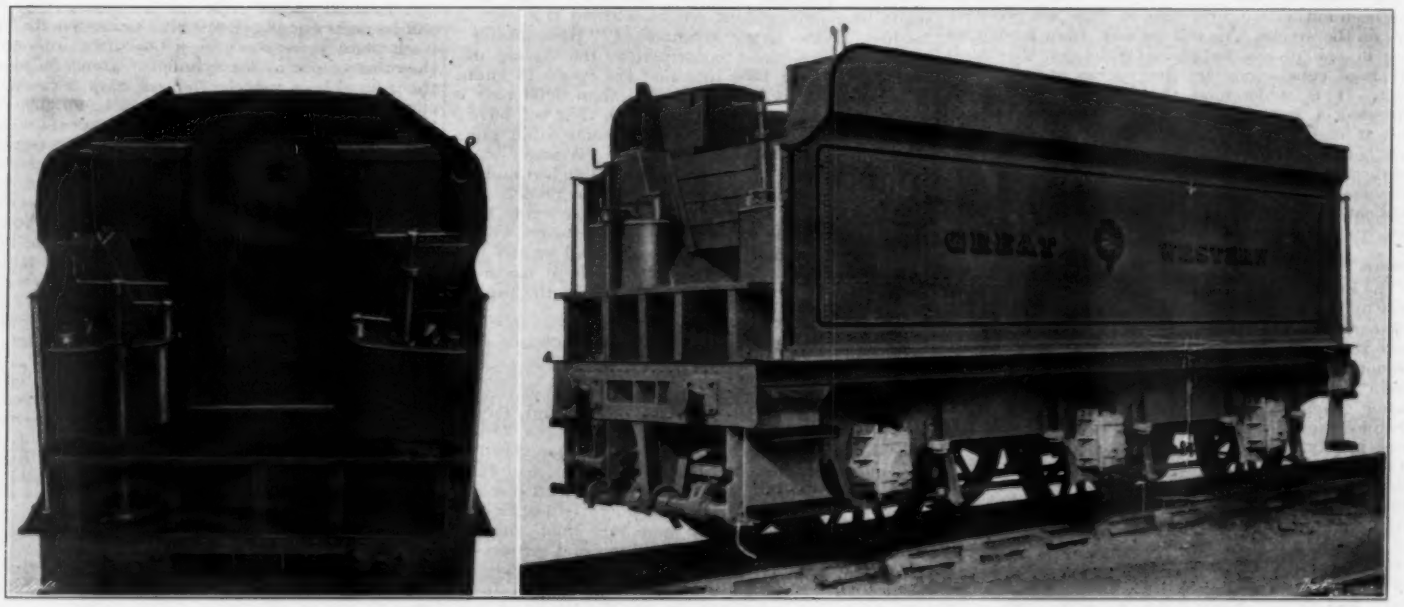
The 200 0–6–0 freight tender engines will be numbered 4207 to 4406 inclusive. Of the batch 95 are being built at Derby, 10 at Crewe, 20 at St. Rollox, and 25 each by Kerr, Stuart, Ltd., Andrew Barclay, Sons and Co., Ltd., and the North British Locomotive Company, Ltd.

Eighty of these engines are intended for service on the Western "A" Division, 20 for the Western "B" Division, 80 for the Midland Division, and 20 for the Northern Division. About 140 of them were completed during the year. They are a repetition of the standard superheated freight engine of the former Midland Railway. The heating surface in the fire-box is 123·50 square feet, and in the tubes 1033·75 square feet. The superheater has 252·75 square feet and the grate area is 21·1 square feet. The tractive effort at 85 per cent. boiler pressure is 24,555 lb.

The 150 shunting tank engines will be numbered 16,400 to 16,549 inclusive. These engines have been given Northern Division numbers, so as to interfere as little as possible with the numbers of existing engines. They are being built as follows:—60 by the North British Locomotive Company, Ltd., 50 by the Vulcan Foundry, Ltd., 25 by the Hunslet Engine Company, Ltd., 15 by W. G. Bagnall, Ltd. Eighty of them are for use on the Western "A" Division, 50 for the Midland Division, and 20 for the Northern Division, and 130 of them are in service.

The 100 2–6–0 mixed traffic engines are, as already noted, of a new design. They are intended for heavy fast goods traffic and heavy excursion trains, and will be numbered 13,000 to 13,099 inclusive. The first thirty are being built at Horwich works and the other seventy at Crewe. Several are already in service, and an engraving of the first of the batch is given in a Supplement, and a weight diagram herewith. The principal particulars are as follow:—

Weight of engine—	
Loaded	66 tons
Light	60 tons
Weight of tender—	
Loaded	42 t. 4 cwt.
Light	21 t. 11 cwt. 2 qr.
Steam brake power	40·2, 71·3, 78·8, 89·2 per cent.



GREAT WESTERN RAILWAY—NEW TYPE OF TENDER FOR "CASTLE" CLASS ENGINES

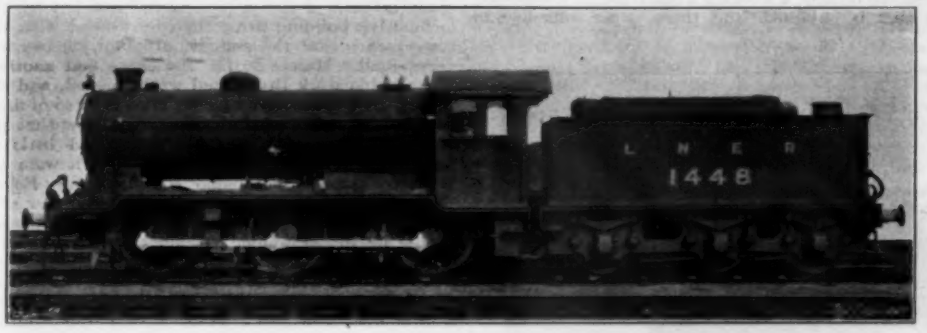
Total steam brake power—	
On bogie	40·2 per cent.
On coupled wheels	79·7 per cent.
To total weight of engine only	73·6 per cent.
Heating surface—	
Tubes (24, 5⅛in.; 164, 1¾in.)	1361 sq. ft.
Fire-box	160 sq. ft.
Total	1521 sq. ft.
Superheater	307 sq. ft.
Grate area	27·5 sq. ft.
Tractive effort at 85 per cent. B.P. (full wheel diameter)	26,580 lb.
Adhesive weight	55 t. 10 cwt.
Factor of adhesion	4·68
Total weight of engine and tender	108 t. 4 cwt.

The three "Garratt" engines, which are being built by Beyer, Peacock and Co., Ltd., will not be ready for service until the early part of this year. They are intended for use in connection with heavy mineral

traffic. They will have two 18½in. by 26in. cylinders at each end, and the tractive effort at 85 per cent. will be 45,620 lb.

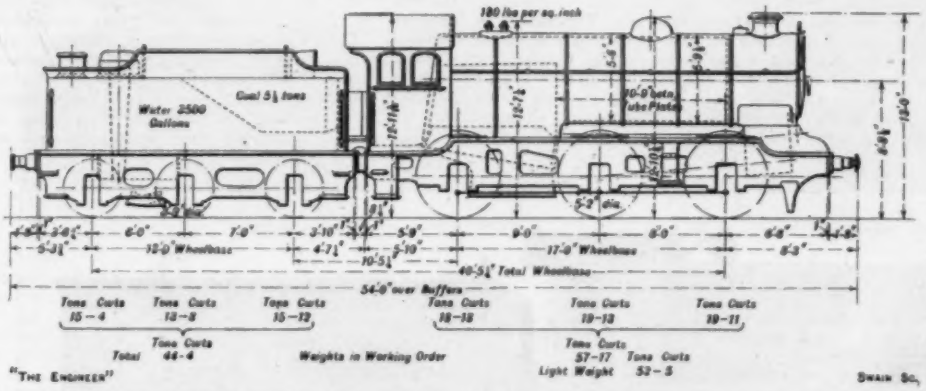
In addition to the foregoing, the St. Rollox works completed eighteen 4–6–0 superheater passenger engines, being the balance of a batch of twenty, numbered 14,630 to 14,649, the first two of which were put into traffic in December, 1925. These are two-cylinder superheater engines, and with slight modifications are a repetition of the former Caledonian "60" class. All these engines are at present in service on the Northern Division.

During the year a "Claughton" type engine, No. 5908, was fitted with the "Caprotti" valve gear, for trial in competition with the usual "Claughton" type engine fitted with the Walschaerts gear. No information regarding it is yet available for publication. It will be remembered that during the year 1925 three 4–6–0 passenger engines and three 0–8–0 freight engines on the Western "B" Section were equipped with "Dabeg" feed pumps. Owing to the industrial condition of the country last year the trials of this apparatus have not been completed.



L. AND N.E. RAILWAY—NEW STANDARD SIX-COUPLED GOODS ENGINE

The coal shortage during 1926, owing to the disturbance in that industry, was to some extent relieved by the prompt fitting of 200 engines for burning oil fuel. The high cost of oil fuel, however, as compared with coal in this country prohibits the use of oil fuel, except in such cases of emergency.



L. AND N.E. RAILWAY—PROFILE AND WEIGHT DIAGRAM OF NEW STANDARD GOODS ENGINE

Great Western Railway.

The locomotive work done at Swindon during the year includes the construction of ten engines of the 4–6–0 "Castle" class, nineteen 2–8–0 T. heavy goods and thirty-five 0–6–2 T. South Wales mineral engines. No new locomotives were produced, but a new tender was designed and constructed for the "Castle" class. Two illustrations of it are reproduced on page 4.

Previously, tenders were built with a portion of the tank carried between the frames below the footplate level, but in the new design the whole of the tank is above the footplate, and also of a larger capacity. This accounts for the greater height from rail level. A tank of this description is much simpler to construct and maintain, and permits of a greatly improved design of underframe. The plates forming the coal space, being sloped towards the centre and front of the tender, automatically feed the coal on to the shovel plate, thus making the tender self-trimming and avoiding the necessity for the firemen to rake the coal forward. A new type of spring gear has been fitted, flat springs being used, and the spring hangers fitted with rocking washers instead of pins. Vacuum and hand brakes are provided, and the power is applied to the brake blocks through compensating gear, which automatically maintains equal pressure on all blocks. The water capacity of the tender is 4000 gallons, and space is provided for 6 tons of coal. The tender is also fitted with the standard water pick-up gear.

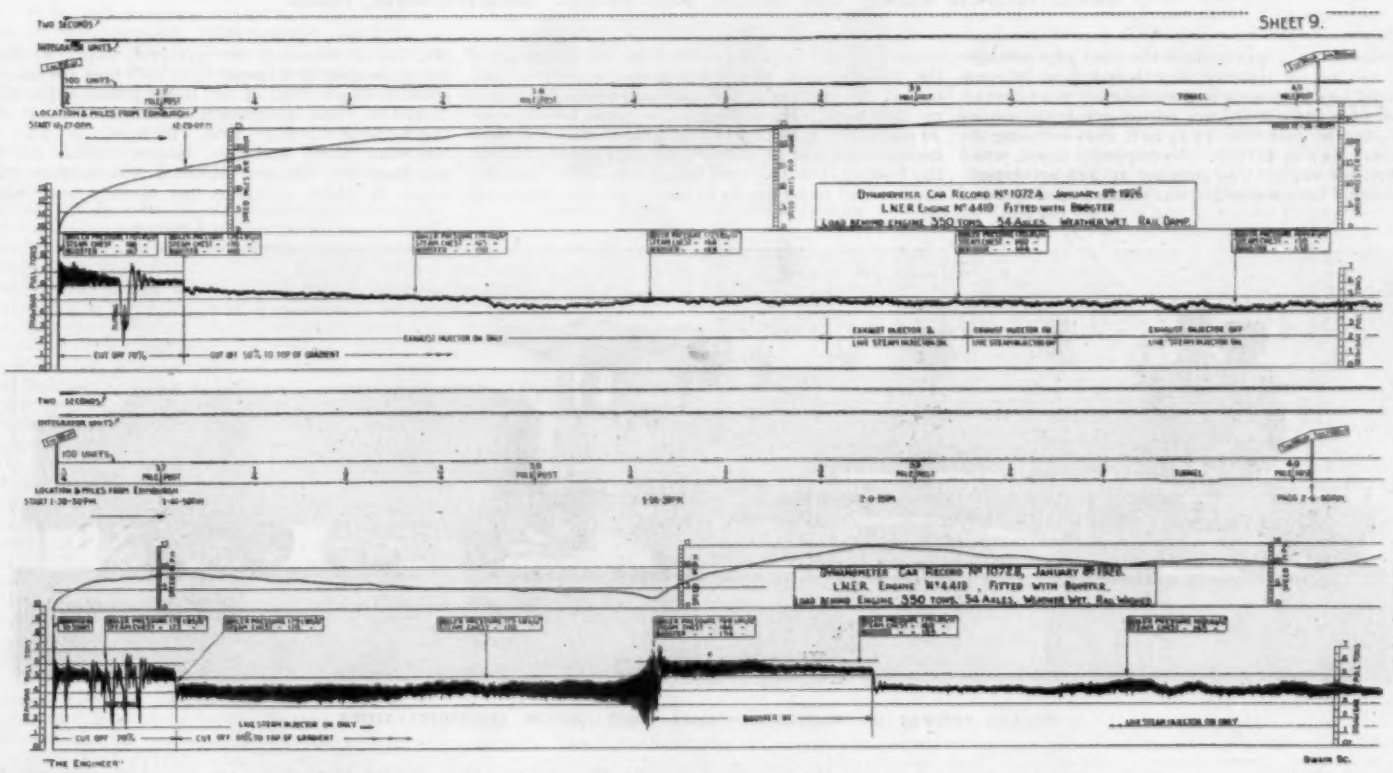
London and North-Eastern Railway.

Owing to the coal strike this company found it necessary to restrict output and curtail work in locomotive depôts to about four days per week during seven months of the year. New work came practically to a standstill, and the company was only able to maintain existing rolling stock. But several of the new standard 0–6–0 goods engines, of which forty-four are being built, were put into service. The engine is of a simple straightforward type, with good boiler capacity. It has 5ft. 2in. wheels, 20in. by 26in. cylinders, and 180 lb. boiler pressure. The ordinary form of Stephenson link motion is fitted, but it is arranged to give the long valve travel of 5½in. for this class of gear, and 1¼in. lap on the valves.

These engines are suitable for working the company's ordinary goods and mineral traffic, and are capable of running at sufficiently high speed for working excursion trains. The large boiler, 5ft. 6in. in diameter, has made them heavier than the ordinary 0–6–0 goods engines, and advantage has been taken of the fact that the bridges on most of the main and important branch lines, both in England and Scotland, are of such strength as to allow engines of this weight to run over them.

Thirty-five engines having wheels 4ft. 8in., instead of 5ft. 2in. in diameter, but similar in all other respects, were constructed for service in Scotland in the Fife and the Lanarkshire coal traffic. They have a tractive power of 28,414 lb., as compared with 25,664 lb. given by the engines having 5ft. 2in. wheels. A photograph of one of the engines with 5ft. 2in. diameter wheels, and a weight diagram are reproduced herewith. The total evaporative surface is 1226·23 square feet and the grate area 26 square feet.

The results obtained with the Lentz valve gear, as fitted on the 0–6–0 goods engine on the Great Eastern Section, have proved sufficiently satisfactory to warrant the extension of the use of these valves, and a Great Eastern Section express passenger engine of the 1500 class, 4–6–0 type, has recently been turned out fitted with this arrangement. It has been decided



L. AND N.E. RAILWAY—DYNAMOMETER RECORDS OF TRAIN WITH ENGINE FITTED WITH BOOSTER

to fit these valves on six more new engines of the 4–4–0 type which are now under construction.

It may also be of interest to our readers to know that the booster, which was originally fixed on one of the Great Northern Section "Atlantic" engines, No. 4419, three years ago, has been considerably modified and improved. The arrangement, as originally supplied from America, had a gear ratio of 2·57, and its power was such as to increase the tractive force by 8500 lb. Compressed air was used for operating the idler gear, and that necessitated the provision of a Westinghouse pump. Furthermore, it was found that there was great difficulty in engaging the gears of the booster when the engine was running, even at speeds of 5 miles per hour. It was also found that there was difficulty in maintaining steam when the booster was in operation, as the blast-pipe arrangement was not satisfactory, and there was no increase in smoke-box vacuum when the booster was running. The alterations which have been carried out consist in altering the gear ratio to 1½ to 1, thus reducing the tractive effort to 4970 lb. As originally fitted, when the booster engine was running at 286 revolutions per minute, the locomotive was running at a speed of 14½ miles per hour; now with the new gear ratio, when the booster is running at the same speed, the speed of the locomotive is 25 miles per hour, this being a much more suitable ratio for a passenger locomotive. The Westinghouse pump for operating the booster gear was removed, and the whole of the mechanism for engaging the idler gear, regulating the supply of steam to the booster and operating cylinder taps, &c., previously done with compressed air, is now operated by live steam from the boiler. The arrangement is such that the booster can be readily and easily engaged without any clashing of gears when the locomotive is running at speeds up to 25 miles per hour. The arrangement of blast-pipe has been completely altered, with the result that when the booster is working a much higher smoke-box vacuum is obtained, and there is no difficulty in maintaining steam when the booster is running.

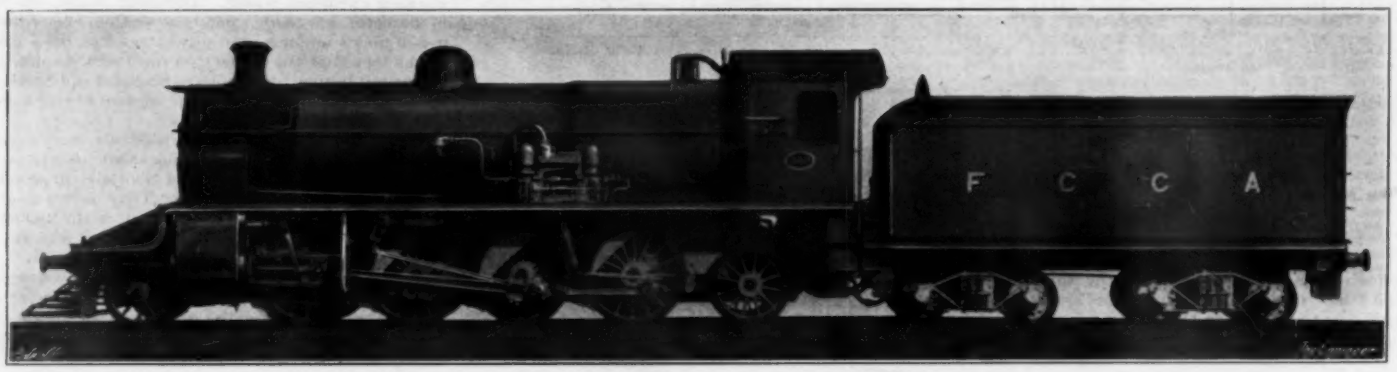
Two tests have been carried out. The first was made with this engine on the Edinburgh–Berwick section of the East Coast route, which contains a gradient of 1 in 96 at Cockburnspath. The weight of the train was 350 tons, including dynamometer car, and it was stopped at Cockburnspath advance signal, 3¼ miles from the top of the gradient. The engine started the train easily with the assistance of the booster, and was notched up to 50 per cent. cut-off 575 yards after the start and worked the train up the bank satisfactorily, the time taken being 10 minutes. A second test was made with the same train attempting to start at the same place without the booster, but this was found impossible, and the booster had to be put in to start, and was taken out as soon as the train was moved. The engine was notched up to 50 per cent. cut-off at the same place as previously, but the booster had eventually to be put in to avoid coming to a stand, the time taken to the top of the bank being nearly three times as long as during the first test.

A reproduction of the dynamometer records is given on page [illegible]5, and the much greater acceleration rendered possible by the booster should be noted. It would appear from the results obtained that the usefulness of "Atlantic" engines can be considerably increased by the provision of the booster.

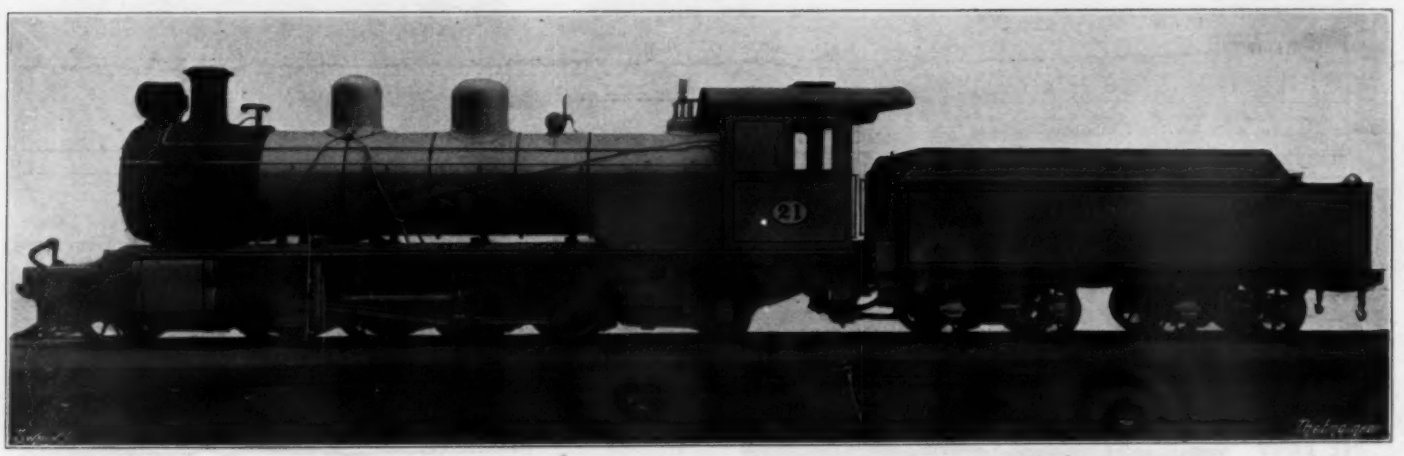
L. AND N.E. RAILWAY—REID-MACLEOD TURBINE ENGINE ATTACHED TO SPECIAL TRAIN

The Locomotive Industry.

The conditions which prevailed in all industries for seven months of the year were felt not less by the locomotive building firms than by others, with the consequence that the annual output of engines was very small. Moreover, for one cause and another, less notable work than usual was achieved, and the reports we have received from the score or so of firms engaged in such work in this country show that the engines built during the year presented little or nothing out of the common. Indeed, if it were not for the Ljungstrom engine completed by Beyer, Peacock and Co., Ltd., there would be no new construction to put on record, although the completion of the all-British steam turbine locomotive on the Reid-MacLeod system may almost be credited to the past year. We hope to deal fully with this engine in an early issue, and to-day we merely give an illustration of it attached to a train. So far opportunities for complete tests in service have not presented themselves, but the engine has shown its capacity to start and haul heavy trains, and its manœuvring qualities have been demonstrated. It is sincerely to be hoped that, like the Anglo-Swedish engine, it may soon be thoroughly tested in main line service. We may fittingly draw attention here to another locomotive, built by the North British Locomotive Company, Ltd., last year. It is a 4–8–2 engine for the Rhodesian Railways, 3ft. 6in. gauge, and though of large size, presents in general respects no very remarkable features. The point of interest in connection with it is that it is fitted with Lentz poppet valves operated from the usual Walschaerts gear. An illustration in one of our Supplements to-day shows how neatly the whole equipment is arranged. It may be of interest to add that the driving wheels are 4ft. 3in. in diameter, the cylinders 20½in. by 26in., the grate area 32·5 square feet, and that the tractive effort at 75 per cent. of the boiler pressure, 190 lb., is 31,270 lb. This company also completed some very nice-looking 2-6-2 tank locomotives for the Egyptian State Railways, besides engines for the Southern and London, Midland and Scottish Railways, to which reference has already been made.



CENTRAL ARGENTINE RAILWAY—EIGHT-COUPLED CROSS-COMPOUND LOCOMOTIVE—BEYER, PEACOCK

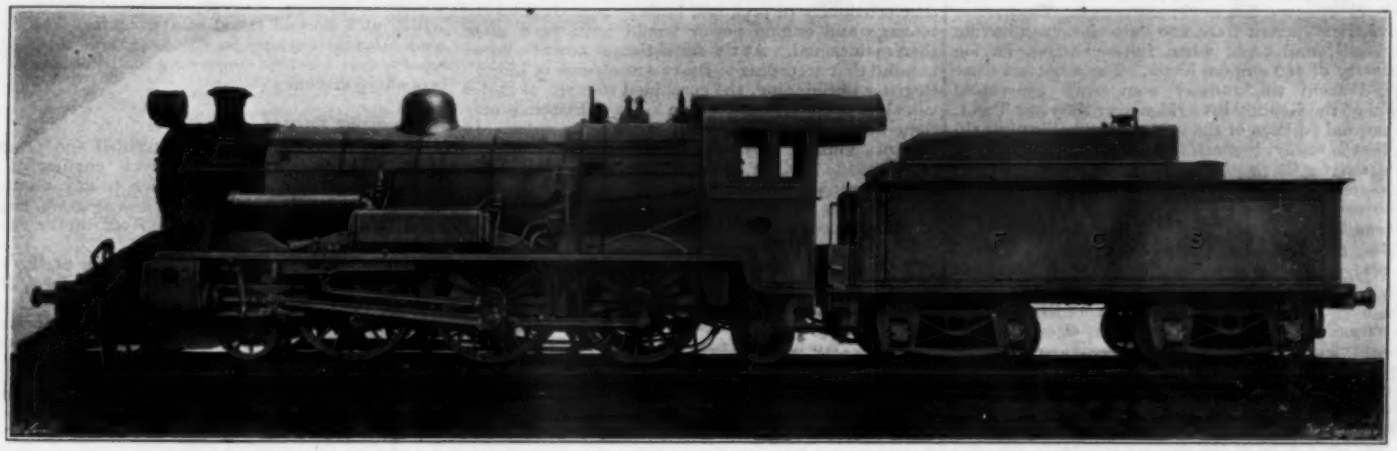


MIDLAND RAILWAY OF WESTERN AUSTRALIA—EIGHT-COUPLED LOCOMOTIVE—KITSON

Robert Stephenson and Co., Ltd., did relatively little building during the year, but they began the construction of six exceptionally large metre-gauge 2–8–2 engines with tenders for the Uganda Railways. These engines will have cylinders 21¼in. by 28in. Sixteen 4–6–0 metre-gauge engines with 16in. by 22in. cylinders were also put in hand.

We have already dealt with the turbine locomotive completed by Beyer, Peacock and Co., Ltd., but a

few words may be said about two other engines constructed by the firm, although they do not offer any features of novelty. One of them is a Garratt engine, from a batch of twelve for the Rhodesia Railways, 3ft. 6in. gauge. Garratt engines are already in use in South Africa, but these are the first of their type for Rhodesia. The wheel arrangement is 2–6–2, 2–6–2, and all the driving wheels are 4ft. in diameter. The leading trucks at each end are of the radial arm type, and the inner axles are fitted with Cartazzi axle-boxes. The cylinders are 16in. by 24in. and the valve chests are separate castings studded in position. Thus they are all interchangeable. Two of them are fitted with Lentz valves driven from the standard Walschaerts gear. The total weight of these engines is 122 tons 3 cwt. and the tractive effort at 75 per cent. of 180 lb. is 34,560 lb. The other engine, which we illustrate, is one of twenty for the Central Argentine



BUENOS AIRES GREAT SOUTHERN RAILWAY—SIX-COUPLED THREE-CYLINDER LOCOMOTIVE—VULCAN FOUNDRY

Railway, 5ft. 6in. gauge. The interesting fact about these locomotives is that the cylinders are arranged on the cross-compound principle with the makers' intercepting valve between the high and low-pressure cylinders. The cylinders, two in number, are 21in. by 26in. and 31½in. by 26in. The coupled wheels are 5ft. 2in. diameter and the weight in working order 81 tons 1 cwt.

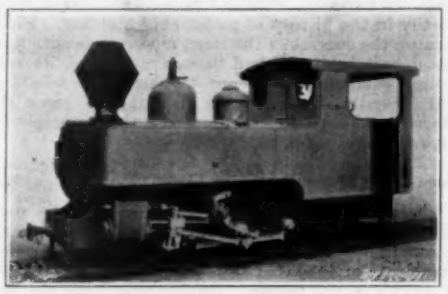
Amongst the locomotives built by Kitson and Co., Ltd., special mention must be made of three 2–8–2's completed early in the year for the Midland Railway of Western Australia, 3ft. 6in. gauge. These engines—page 6—have to burn very poor coal and had, therefore, to be provided with exceptionally large fire-boxes for their size, the fire-box heating surface being 120 square feet out of a total evaporating surface of 1208 square feet. As the axle weight is limited to 9·5 tons, careful designing was called for. The cylinders are 18in. by 24in., the coupled wheels 46½in. in diameter, and the working pressure 160 lb. We are informed that these engines have done very well in service, hauling a train of 407 tons behind the tender up a gradient of 1 in 60 with curvature. Despite the poor coal, they steamed excellently. We may add that the double bogie tender carries 7 tons of coal and 2800 gallons of water.

During the year Sir W. G. Armstrong, Whitworth and Co., Ltd., completed a fair number of orders begun in 1925, included amongst them being several three-cylinder engines for oil fuel for the Buenos Ayres Great Southern Railway, and they began the construction of three-cylinder locomotives for the Buenos Ayres and Pacific Railway and 4–8–2's for the Queensland and Nigerian Railways. Nasmyth, Wilson and Co., Ltd., delivered engines for the Barsi Light Railway, the Nigerian Railway, the G.I.P.R., and the Ceylon Railway, but none of them present features of exceptional interest. The Vulcan Foundry Company, Ltd., completed five 4–6–0 Mail engines for the Bengal-Nagpur Railway, twenty-one 2–6–2's for the Uganda Railway, eleven 2–8–2's for the Tanganyika Railway, ten 4–6–0's for the Ceylon Railway, fifty 0–6–0 tank engines for the L.M.S. Railway, and twenty 4–6–2's for the Buenos Aires Great Southern Railway. The last named are of the three-cylinder type and present several interesting features. One of them is illustrated herewith. The working pressure is 200 lb., the cylinders are 19in. by 26in., and the coupled wheels are 6ft. 6in. diameter. The total evaporative surface is 1887 square feet, the grate area 29·3 square feet, and the superheater area 410 square feet. At 80 per cent. the tractive effort is 28,880 lb. The engine weighs 86 tons with 51 on the drivers, and the tender weighs 62 tons with 31 on each bogie. Each cylinder has its own Walschaerts valve motion. A bogie of the swing link type is provided at the front end and a radial axle-box truck at the hind end. To negotiate a 100 m. curve a total side play of 3½in. and 2½in. is allowed for at the front and back respectively, and the centre coupled wheels are flangeless. Liquid fuel is used.

Light Locomotives.

Turning now to the smaller classes of locomotives, we illustrate an interesting engine turned out by John Fowler and Co. (Leeds), Ltd., for hauling potatoes on the estate of Mr. J. H. Dennis at Nocton, Lincolnshire. This neat little engine runs on a 60 cm. railway and has 8in. by 12in. cylinders. It replaces small motor locomotives which were found not sufficiently powerful to pull heavy loads up severe gradients. Messrs. Fowler's tell us that the demand for light motor locomotives is increasing abroad, especially upon sugar plantations, where alcohol fuel is made locally. For example, such engines have been sent to Fiji, Queensland, and Natal. Motor locomotives of this type are built up to as much as 200 horse-power, and owing to the reduction gearing are able to haul greater loads than a straight steam engine of the same weight. The engines have four or six wheels coupled and the drive is taken on to the coupling rod from a jack shaft at the leading end.

Two special light locomotives were built during the year by Peckett and Sons, Ltd., one for a limestone quarry in Somerset and the second for a large Yorkshire quarry. These are relatively large engines, the first having 12in. by 18in. outside cylinders and weighing 26½ tons in working order. It has a saddle tank with a capacity of 660 gallons. The second has 13in. by 18in. inside cylinders and carries in a saddle tank 800 gallons of water. It weighs 28½ tons loaded



NARROW-GAUGE LOCOMOTIVE—FOWLER

and is fitted with steam and hand brakes. Both engines are carried on six-coupled wheels, 3ft. 0½in. diameter. The gauge is 4ft. 8½in.

Bridges in 1926.

Caversham Bridge.—In one of our Supplements is given a view of the new bridge over the river Thames at Caversham, which was thrown open for traffic in May of last year. It supersedes a wrought and cast steel structure, which was erected in 1869, and had spans of 63ft. carried upon cast iron cylindrical piers, the island near the centre of the river being utilised as a support. The new structure, which is of reinforced concrete, built on the Hennebique system, has two arches having an angle of skew of 78 deg., and clear spans of 126ft. 4½in., and 106ft. 4½in. on the Reading and Caversham sides respectively. The shore abutments are of mass concrete and a further mass concrete central abutment was constructed in place of the island which originally existed near the middle of the river, but which has now been demolished. The total length of the whole structural work is 457ft. 6in., there being reinforced concrete approaches on each side of the river spans. The width between the parapets is 56ft., which affords room for a carriageway 32ft. wide and two footpaths, each 12ft. wide. The gradient of the carriageway on the Reading side is 1 in 30, while on the Caversham side it is 1 in 24. These figures could not be departed from on account of pre-existing buildings, and also on account of the Thames Conservancy's requirements as to headroom.

The theoretical loading adopted as a basis of the design is the standard loading specified by the Ministry of Transport, consisting of trains of 20-ton tractors followed by 13-ton trailers, and giving a possible total rolling load upon the bridge of 850 tons. The two arched spans consist of six reinforced concrete ribs, each designed upon the elastic principle, fixed at the ends in heavy mass concrete abutments carried about 20ft. below water level. The parapets of the upper deck are in Aberdeen granite, and of the lower deck in reinforced concrete to preserve the general architectural lines of the structure. A reinforced concrete cantilevered stairway is carried down the north face of the east promenade bay to give access to the adjacent islands, and ducts are provided under the footpaths for the accommodation of water, gas and electric mains, the pavement slabs being reinforced to form decking over these ducts.

The cost of the structure was rather less than £70,000.

The Lea Marshes Viaduct.—There was completed towards the end of the year an extensive reinforced concrete viaduct which is to carry the Walthamstow-Edmonton section of the new North Circular Road across the Lea Valley Marshes. This structure, a view of which is also given in the Supplement, cost £130,000, and took eighteen months to build. For its construction 17,000 tons of concrete were required. It is half a mile long, and is supported by 600 columns of reinforced concrete. By it a 40ft. roadway, flanked on each side by a 10ft. paved footway, is carried across the Marshes, and three waterways are crossed—an aqueduct of the Metropolitan Water Board, the Coppermill Stream and the river Lea. These crossings are effected by three bridges, which are also of reinforced concrete, and which are embodied in the viaduct. The Water Board's aqueduct is crossed in a single span.

The Lea Valley Marshes flood with great rapidity, and that was one of the chief difficulties with which the engineers who built the viaduct had to contend. Where the viaduct crosses more solid ground, the columns are supported on mass concrete bases some 6ft. square, but, on the marshland, support had to be obtained by means of concrete piles driven deep into the alluvial soil by the vibro-piling process. For the abutments of the bridges alone over a thousand piles had to be driven.

Architecturally, the viaduct is imposing. Each entrance is flanked by concrete towers, 50ft. high, and every 20 yards along its entire length are cylindrical gas beacons on ornamental concrete columns.

With the opening of the viaduct, direct road communication over the hitherto often impassable marshes between North and East London will be assured, and the detour by Tottenham or Chingford obviated.

Railway Drawbridge at Keadby.—The drawbridge at Keadby on the London and North-Eastern Railway, a view of which is also given in the Supplement, carries the Doncaster to Grimsby and Immingham main line of the railway over the Keadby Canal of the Sheffield and South Yorkshire Navigation Company. It is the first of its kind to be built in this country, and is hence of peculiar interest, the more so since, so we gather, it has operated most successfully from the time it was put into service. It was described at considerable length so recently in our columns—November 5th last—that it will not be necessary here to enter into any great detail. It may be explained, however, that it replaces a bridge of the swing type which was built in 1866, and which was too weak to bear the increased weight of present-day traffic, only one engine being allowed on it at a time, and there being a speed restriction over it of 8 miles per hour.

The present bridge is designed to be withdrawn horizontally when it is desired to leave the canal free for the passage of barges. It was constructed practically complete in a position clear of the railway without interfering with the existing bridge or with the traffic on the railway until the actual removal of the

old structure took place, so that no temporary diversion of the main line was necessary. No part of the bridge structure is below the level of the water in the canal. The bridge is designed to carry the British Standard unit loadings and allows for twenty units, the material being stressed and designed in accordance with the British Standard Specification for Girder Bridges. The main longitudinal girders are 57ft. long and 4ft. 6in. deep. The two connecting girders, which are fixed 5ft. apart, transversely across the main girders, and carry the three main rollers on which the bridge travels, are 91ft. 6in. long and 4ft. 6in. deep, the depth being reduced at three places to provide clearance for the lifting jacks when the bridge is travelling.

The structure is traversed to and fro by means of electrically driven gear and steel ropes, two motors, each of 35 brake horse-power running at 450 revolutions per minute being provided, though only one is actually needed for the work, one acting as a stand-by. The steel ropes are 3in. in circumference. The motors receive their current from two batteries, each having sixty cells, and each, when fully charged, having a capacity of 450 ampère hours. These batteries are charged from the railway company's generating station at the Keadby lift bridge over the river Trent. The normal position of the bridge is for railway working, that is to say, it spans the canal, and it has to be withdrawn for the passage of craft. The time specified in the contract for opening or closing the bridge was 90 seconds; actually, the time of operation is 60 seconds.

When the time came to substitute the new for the old bridge, the railway was only closed for thirty hours. On Saturday, June 26th, at midnight, both main lines were closed for traffic, and the work of demolition of the old swing bridge was at once begun, oxy-acetylene flames being largely employed for the purpose. The line was opened again for traffic over the new bridge at six o'clock on the following Monday morning. The new bridge was built to the designs of Mr. C. J. Brown, M. Inst. C.E., Chief Engineer of the Southern Area of the railway company, the contractors being Sir Wm. Arrol and Co., Ltd., of Glasgow.

Berwick Bridge.—In the same Supplement will be found a view of a reinforced concrete bridge, which is being built over the Tweed at Berwick. The view shows the progress made with the construction up till near the end of the year. The work, which was commenced in January, 1925, is being carried out to the designs of Messrs. L. G. Mouchel and Partners, of Westminster. It is 1405ft. long by 46ft. in width, made up of a 30ft. carriageway and two 8ft. footpaths, and there are four arched spans of 361ft. 6in., 285ft., 248ft. and 167ft. respectively, carried on five mass concrete piers, with a reinforced concrete viaduct at each end of the bridge. The rise of the longest span is 45ft., and the ribs of the three large spans are hollow from the springing to about one-third of their span, the centre portion being solid. Vertical columns of various sizes carry the reinforced concrete decking and beams, and the road surface consists of 2in. of asphalt laid direct on to the decking. The parapets are to be of masonry.

Good progress was made during the past year. The five main pier foundations were practically completed, though the pier in the river between the two large spans was somewhat difficult, it having been found necessary to drive 168 No. 35 reinforced concrete piles in its foundation, owing to a fault in the river bed at that point. The 167ft. and the 248ft. arches were completed and the temporary staging removed. The concreting of the 285ft. span was about two-thirds finished and the staging is being erected for the largest and final span. The foundations and columns for the viaducts were well forward and a commencement was made with the approaches. It is interesting to note that this is the longest road bridge in Great Britain, and that the three large spans are also the largest reinforced concrete arches in the country. Its cost, it is estimated, will be £160,000.

New Floating Roadway at Seacombe Ferry.—On the Mersey an important work of the year was the completion of a new floating landing stage and roadway for goods traffic at Seacombe Ferry. The work is only part of a more complete scheme for the construction of a longer landing stage. The floating roadway is illustrated in another of our Supplements. It was built to the designs of Messrs. Wilton and Bell, of Westminster and Liverpool, and the contractors were the Cleveland Bridge and Engineering Company, Ltd., of Darlington, for the structure, and Nott, Brodie and Co., Ltd., of Bristol, for the necessary excavation work. The roadway has an overall length of about 590ft., with an extreme width over the roadways and pathways of 45ft., and it is stated to be the largest structure of its type yet built. The length was necessary on account of the very large tide range of 32ft. 6in. on the river. With the bridge resting on its concrete beds at low water the maximum gradient is only 1 in 22. There are five floating spans, which are linked to each other and to the landing stage and shore by six suspended spans. A neat type of interlocking comb joint is used on the wheel tracks of the roadways. There are three roadways, one for up traffic and one for down traffic, with a third which may be used either as a relief for the other two in case of breakdown or for fast-moving up traffic. Footways are provided at either side of the bridge and between the roadways. Provision is made in the excavation for docking the pontoons.

Motor Vessels and Marine Oil Engines in 1926.

THE number of motor vessels built and engined during the past year was smaller than in either of the two preceding years. In Table I. we give the returns for the period 1920 to 1926 inclusive. The temporary reduction in output, to which we refer, must, to a large extent, be attributed to the shortage of steel materials and the general stagnation in the shipbuilding yards, which was caused by the protracted coal trade dispute. Had normal working been possible throughout the whole of the year, there is little doubt that continuity of progress, both as regards totals of tonnage and engine power would have been more than maintained. At the same time it must be borne in mind that according to the recent returns of Lloyd's Register of Shipping, the combined tonnage of motor vessels now under construction in Great Britain is only some 35 per cent. of the total tonnage on order. In foreign countries that proportion is 57 per cent., and for the whole world it is 48 per cent. As Lord Kylsant recently reminded us in his Presidential address to the Institute of Marine Engineers, the importance of these figures cannot be over emphasised.

For the year 1926 we again hold the leading position in the world as motor ship builders, but can we hope always to retain that proud position, if foreign-built motor tonnage increases at a faster rate than does similar tonnage constructed in this country for British owners? We have to face increased activity in the building of motor vessels abroad, often with State aid, and the preference of many owners, for engines built in the shops from which the design originally emanated. It is only with increasing application that our lead will be kept.

TABLE I.—*Vessels of 1000 Gross Tons and Upwards Fitted with Marine Oil Engines and Completed in Great Britain and Ireland during the Years 1920–1926 Inclusive.*

Year	1920.	1921.	1922.	1923.	1924.	1925.	1926.
Number of vessels completed	7	15	17	14	43	44	30
Total gross tons	53,407	83,980	114,527	78,862	231,764	282,325	212,063
Total I.H.P. of propelling machinery	31,140	42,860	69,820	49,137	145,130	180,125	160,460

Following our usual custom we give in Table II. a list of the important motor vessels built during the year. In two ways 1926 will be remembered as noteworthy in the history of motor ship building. First, because the success of the large motor passenger liner was definitely established first in respect of its reliability, economy, and speed-keeping characteristics; and secondly, because with that success came the effective utilisation of the double-acting principle for engines operating on the four-stroke cycle.

Some Large Motor Passenger Liners.

The first large motor passenger liner to be commenced was the Fairfield-built quadruple screw-liner Aorangi, fitted with Fairfield-Sulzer type engines. At the end of 1926 that ship had completed two years of service in the Pacific. During that time she was not laid off for the usual annual survey, and the longest time in port for inspection or refit was four days at Sydney and four days at Vancouver. We are informed that during the whole of the two years in which she has been in operation she has exceeded her guaranteed speed, and was ahead of time at each port at which she touched. Not less successful was the sea experience gained with the Swedish-American Liner Gripsholm, which, it will be recalled, was built by Sir W. G. Armstrong, Whitworth and Co., Ltd., and engined by Burmeister and Wain, Ltd. That vessel has now been in service more than a year, and as the result of good voyages, her owners have placed the order for a second ship. Unfortunately for the British tenderers the order was gained by Germany. The propelling machinery will again be furnished by Burmeister and Wain, Ltd., of Copenhagen. At the beginning of the year the first large liner for the South American service of the Royal Mail Steam Packet Company was placed in commission. The Asturias was fully described in our issue of February 26th, and was included in our last year's returns. She has a gross tonnage of 22,000, and is equipped with Harland B. and W. type four-cycle double-acting engines in two units of eight cylinders each, designed for a total output of 20,000 indicated horse-power, or 15,000 brake horse-power when running at a normal speed of about 115 revolutions per minute. The Asturias made several round voyages in the year, and she fully justified the anticipation of her owners and builders. Her sister liner, the Alcantara, was recently completed, and about the middle of the year another almost similar vessel, the Carnarvon Castle, was delivered by Harland and Wolff, Ltd., for the African mail service of the Union Castle Mail Steamship Company, Ltd. That liner has already made two or three most successful voyages, and we illustrate her in one of to-day's Supplements. Her well-proportioned lines and superstructure with the two broad and low funnels, give the ship that distinguished appearance which, in common with the Asturias and Alcantara, we have learned to associate with Harland and Wolff's larger motor vessels. In all these ships twin-screw eight-cylinder engines of the four-cycle double-acting type were installed.

Two other noteworthy motor liners were completed by the same builders for the African Mail service of the Elder Dempster Line. We refer to the Accra and Apapa. The owner of these new vessels, the British and African Steam Navigation Company, Ltd., was a pioneer in introducing motor vessels for passenger carrying, its first ship being the Aba of 1921. The striking advance made in the short space of five years is well illustrated by the view of the Accra, Fig. 1 opposite, which shows the appearance of the new and larger type of vessel. With a length of about 470ft. and a gross tonnage of 9300, the Accra and Apapa are both equipped with twin-screw engines of the double-acting type. They are designed to develop 7500 I.H.P. at a normal speed of 100 r.p.m. The Accra made several voyages in the year, and the best of reports were received concerning the behaviour of her propelling machinery.

Double-acting Engines.

In the foregoing we have outlined the progress made with double-acting four-cycle engines of the Burmeister and Wain type, which to-day occupy a leading position in marine oil engine progress, largely on account of the Harland and Wolff motor vessels above referred to.

Another notable double-acting engine of the two-stroke cycle type, was that built in the form of an experimental unit by Richardsons, Westgarth and Co., Ltd. Details of its construction and performance were given by Mr. W. S. Burn in papers read before the Institute of Marine Engineers and the North-East Coast Institution of Engineers and Shipbuilders, and is shown in Fig. 2, page 10. It has a 26¾in. by 47¼in. cylinder, and is designed to develop 800 B.H.P. per cylinder at a normal speed of 90 r.p.m. The design is characterised by a remarkable symmetry and simplicity of the cylinder parts, and a noteworthy feature is the arrangement of the cam shaft with engine controls in one unit at the base of the frame. Although still in the experimental stage, good progress has, we understand, been made, and it is hoped that the new engine will be on the market in the near future.

Another double-acting engine of the year was a Beardmore-Tosi, built by the Vulcan Works of Hamburg to the designs of William Beardmore and Co., Ltd., of Dalmuir. Two sets of engines were installed in that firm's motor vessel, the Wulsty Castle. They are in three-cylinder units, designed for a total output of 1800 S.H.P. The cylinders are 20in. by nearly 24½in., and full power is developed at 240 r.p.m. The engine speed is reduced to 80 revolutions at the propeller by single-reduction gearing, combined with a Vulcan oil-operated hydraulic mechanical clutch. The trials showed that the machinery possessed excellent manœuvring capabilities, and the results of the first voyage of the Wulsty Castle will be awaited with interest.

During the year a further three-cylinder 2000 S.H.P. double-acting sliding-cylinder engine, built by Barclay, Curle and Co., Ltd., at the firm's North British Engine Works, was installed in the motor oil tanker Storsten for owners at Tonsberg, in Norway.

At Wallsend an active programme of double-acting engine construction was embarked upon by the North-Eastern Marine Engineering Company, Ltd., in collaboration with the Werkspoor Engine Works, Amsterdam. The first engine of the North-Eastern-Werkspoor double-acting four-cycle type was built and fitted in the Alfred Holt vessel Stentor, which has a deadweight carrying capacity of about 10,000 tons. Particulars of this ship are given in Table II., and a full description of the machinery will be found in our issue of May 28th last. The firm has also under-construction several sets of similar engines for the Anglo-Saxon Petroleum Company, Ltd., of London, which engines, however, will be fitted with the Zulver-Lugt patented rotary valve gear, particulars of which are given in our issue of February 12th.

During the year an important step was taken by Vickers Ltd., of Barrow, in securing the British manufacturing rights for the M.A.N. double-acting two-cycle engines. Full details of this engine, along with test results were given in two articles which we published on March 6th and April 12th. The first British-built engines of this type are to be constructed for an Admiralty vessel.

Single-acting Four-cycle Engines.

Among the single-acting four-cycle engines of last year, by far the largest number constructed were of

the Harland-B. and W. type. Of these, Harland and Wolff, Ltd., built eight sets of six-cylinder engines, which were installed in four ships of the Bank Line, Ltd. Two eight-cylinder motors were supplied for the Western Australian Government ship Koolinda, which ran her trials just before the close of the year. She is a sister ship to the Kangaroo, which was with 35½in. cylinders, which was illustrated in our last year's annual article, was postponed. John Brown and Co., Ltd., built, however, a motor tanker, the British Diplomat, in which twin-screw machinery of some 2500 S.H.P. was erected. At the Govan yard of the Fairfield Shipbuilding and Engineering Company, Ltd., the Shropshire, a 10,000-ton motor Whitworth and Co., Ltd., for the Christen Smith Rederi, of Oslo. Particulars of all these ships are given in Table II. Three other ships, which are too small to be included in our returns, were finished during the year and were equipped with Sulzer type engines, manufactured at Winterthur. The motor yacht Mingary, built by Alex. Stephen and Sons, Ltd., of

TABLE II.—MOTOR VESSELS AND MARINE OIL ENGINES OF 1926.

Name of vessel.	Owners.	Shipbuilder.	Hull particulars.				Type of propelling machinery.	Main engine particulars.					Number and K.W. size auxiliary generator sets
			Length B.P.	Breadth m'lded.	Depth m'lded.	Gross tonn'ge		Cyl. bore.	Piston stroke.	R.p.m.	Total I.H.P.	Total S.H.P.	
			Feet.	Feet.	Feet.								
Accra	Elder, Dempster and Co.	Harland and Wolff, Ltd. ..	450·8	62·3	31·3	9,337	Two 6-cyl., 4-cycle, D.A., Harland-B. and W.	680 mm.	1,400 mm.	100	7,500	5,600	3, 200 K.W. & 1, 50 K.W.
Apapa	,, ,, ,,	,, ,, ,,											
Athelking	British Molasses Co., Ltd., London	Swan, Hunter and Wigham Richardson	474·9	64·4	36·5	9,557	Two 6-cyl., 2-cycle, S.A., Neptune	22½ in.	45 in.	103	5,300	4,000	Steam auxiliaries
Alcantara	Royal Mail Steam Packet Co., London	Harland and Wolff, Ltd. ..	630·5	78·5	40·5	22,150	Two 8-cyl., 4-cycle, D.A., Harland-B. and W.	840 mm.	1,500 mm.	110 to 115	20,000	15,000	4, 400 K.W. & 1, 75 K.W.
Belpariel	Christen Smith Rederi, Oslo	Sir W. G. Armstrong, Whitworth and Co., Ltd.	414·4	67·1	31	7,203	Two 4-cyl., 2-cycle, S.A., Armstrong-Sulzer	600 mm.	1,060 mm.	110	3,600	2,700	3 at 100 K.W.
Beljeanne													
Belray	Christen Smith Rederi, Oslo	Sir W. G. Armstrong, Whitworth and Co., Ltd.	318	46	23·25	2,888	One 4-cyl., 2-cycle, S.A., Armstrong-Sulzer	600 mm.	1,060 mm.	110	1,875	1,350	2 at 35 K.W. and steam
Black Sea*	,, ,, ,, ,,	,, ,, ,,											
	Black Sea Shipping and Oil Co., Ltd., London	Sir W. G. Armstrong, Whitworth and Co., Ltd.	310	42	22·1	2,961	One 4-cyl., 2-cycle, S.A., Burgerhout-Nobel	20⅞ in.	37½ in.	95	1,200	900	Steam auxiliaries
British Diplomat	British Tanker Co., Ltd., London	John Brown and Co., Ltd...	410	54·25	32·68	6,484	Two 4-cyl., 2-cycle, S.A., Brown-Sulzer	600 mm.	1,060 mm.	105	3,400	2,500	2 at 50 K.W.
Cape York	Cape York Motor Ship Co., Ltd., London	Lithgow's, Ltd.	410·0	54	27	5,027	Two 6-cyl., 4-cycle, S.A., Hawthorn-Werkspoor	560 mm.	1,000 mm.	125	3,000	2,020	3, 65 K.W. & 1, 10 K.W.
Carnarvon Castle..	Union-Castle Mail Steamship Co., Ltd., London*	Harland and Wolff, Ltd. ..	630·7	73·5	41·5	20,063	Two 8-cyl., 4-cycle, D.A., Harland-B. and W.	840 mm.	1,500 mm.	95 to 100	20,000	13,000	4 at 400 K.W.
Dolores de Urquiza	Argentine Navigation Co., Ltd., London	A. and J. Inglis, Ltd... ..	340·25	57·5	19·75	2,218	Two 6-cyl., 4-cycle, S.A., Harland-B. and W. trunk supercharged type	400 mm.	750 mm.	200	1,910	1,432	2 at 55 K.W.
Java	J. Ludwig., Mowinckel's Rederi, Bergen	Furness Shipbuilding Co., Ltd.	470	62·35	35·75	8,875	Two 6-cyl., 4-cycle, S.A., Kincaid-Harland-B. & W.	630 mm.	1,300 mm.	110	4,100	3,100	Electric and steam
Koolinda	Government of Western Australia	Harland and Wolff, Ltd. ..	330	50	27·5	4,100	Two 8-cyl., 4-cycle, S.A., Harland-B. and W.	640 mm.	1,100 mm.	125	5,000	3,750	3 at 110 K.W.
Modavia	Donaldson Line, Ltd., Liverpool	Vickers Ltd.	385	53·5	28	5,000	One 8-cyl., 4-cycle, S.A., Vickers	30 in.	45 in.	110	3,100	2,700	Electric and steam
Oakbank	Bank Line, Ltd., Glasgow..	Harland and Wolff, Ltd. ..	434	53·75	27	5,200	Two 6-cyl., 4-cycle, S.A., Harland-B. and W.	630 mm.	960 mm.	125	3,100	2,300	2 at 65 K.W.
Olivebank	,, ,, ,, ,,	,, ,, ,,											
Speybank	,, ,, ,, ,,	,, ,, ,,											
Springbank	,, ,, ,, ,,	,, ,, ,,											
Orestes	Alfred Holt and Co., Liverpool	Workman, Clark and Co., Ltd.	452	58	35·25	7,882	Two 8-cyl., 4-cycle, S.A., Burmeister and Wain supercharged	740 mm.	1,500 mm.	110	8,000	6,000	4 at 100 K.W.
Idomeneus													
Phrontis	Alfred Holt and Co., Liverpool	Caledon Shipbuilding and Engineering Co., Ltd.	425	54·5	31·75	6,617	Two 8-cyl., 4-cycle, S.A., Burmeister and Wain supercharged	630 mm.	1,100 mm.	125	4,800	3,700	4 at 100 K.W.
Shropshire	Bibby Steamship Co., Ltd., Liverpool	Fairfield S. and E. Co., Ltd.	482	60	36·25	10,360	Two 8-cyl., 2-cycle, S.A., Fairfield-Sulzer	28 in.	39 in.	110	9,600	7,700	3 at 265 K.W.
Silverash	Silver Line, Ltd., London ..	Joseph L. Thomson and Sons, Ltd.	425	58·3	29	5,299	One 4-cyl., 2-cycle, opposed-piston, Doxford	680 mm.	2,720 mm. comb'd	90	5,500	5,000	3 at 100 K.W.
Silverbeech	Silver Line, Ltd., London ..	Sir James Laing and Sons, Ltd.	425	58·3	29	5,311	One 4-cyl., 2-cycle, opposed-piston, Doxford	680 mm.	2,720 mm. comb'd	90	5,500	5,000	3 at 100 K.W.
Stentor	Alfred Holt and Co., Liverpool	Caledon Shipbuilding and Engineering Co., Ltd.	425	55·5	31	6,600	One 6-cyl., 4-cycle, D.A., North-Eastern-Werkspoor	820 mm.	1,500 mm.	95	5,000	4,000	4 at 100 K.W.
Storsten	Tonsberg Rederi, Tonsberg	Barclay, Curle and Co., Ltd.	388·5	52·7	29	5,240	One 3-cyl., 2-cycle, D.A., North British	24 in.	2×44 in.	96	2,700	2,000	Electric and steam
Tynefield	Hunting Steam Ship Co. (1919), Ltd., Newcastle	Sir J. Laing and Sons, Ltd...	395	54·5	32	5,856	One 4-cyl., 2-cycle, opposed-piston, Doxford	580 mm.	2,320 mm. comb'd	77	2,900	2,550	Steam auxiliaries
Wulsty Castle* ..	William Beardmore and Co., Ltd., Glasgow	J. Blumer and Co., Ltd. ..	356·3	47·7	23·9	3,566	Two 3-cyl., 4-cycle, D.A., geared Vulcan-Beardmore-Tosi	20 in.	24½ in.	240	2,400	1,800	Steam auxiliaries
Yomah	M. V. Yomah Co., Ltd., Glasgow	William Denny and Bros., Ltd.	400	52	31	5,047	One 6-cyl., 2-cycle, S.A., Denny-Sulzer	600 mm.	1,060 mm.	100	2,500	1,875	Steam auxiliaries

* Steamships converted to motor ships.

supplied by the same builders over eleven years ago. Harland and Wolff also supplied twin-screw machinery of the trunk piston type for the motor train ferry Dolores de Urquiza, a vessel built by A. and J. Inglis, Ltd., of Glasgow, for the Argentine Navigation Company, Ltd. She was described in our issue of October 29th, and is illustrated in one of two-day's Supplements. The Kincaid type of B. and W. engine was also fitted in the molasses tanker Java, which was constructed by the Furness Shipbuilding Company, Ltd., and engined by J. and G. Kincaid, Ltd., of Greenock. At Bedford several auxiliary engines of the Allen-B. and W. type were built by W. H. Allen, Sons and Co., Ltd. In Table II. we give particulars of three British-built vessels for Alfred Holt and Co., Ltd., Liverpool, which have been fitted with machinery constructed by Burmeister and Wain, Ltd., of Copenhagen, and fitted with superchargers. The same firm supplied two six-cylinder engines for the motor yacht Eros, built by Ramage and Ferguson, Ltd., of Leith. At the Barrow yard of Vickers Ltd. there was completed a single-screw vessel, the Modavia, for the Donaldson Line, which was equipped with four-cycle single-acting engines of the Vickers type.

The twin-screw Hawthorn, Leslie-Werkspoor engines which were built some time ago were placed during the year in the Cape York, a cargo ship constructed by Lithgows, Ltd., at Port-Glasgow. This ship was tested by the Marine Oil Engine Trials Committee, and an abstract of the Committee's report, with the discussion, was given in our issue of December 17th.

A new four-cycle single-acting engine, which will probably be used for marine auxiliary purposes was completed by Belliss and Morcom, Ltd., of Birmingham. It was described in our issue of November 12th.

Single-acting Two-cycle Engines.

The leading position in two-cycle construction during 1926 was again held by the Sulzer type of engine. It is to be regretted that, owing to the change of plans on the part of the New Zealand Shipping Company, Ltd., with regard to their passenger liners, the completion of large-power Brown-Sulzer engine passenger liner for the Bibby Line, was completed, and provided with twin-screw Fairfield-Sulzer engines of 7700 total B.H.P. Some progress was also made with the sister ship to the Houlder liner Upwey Grange, which was completed last year, and is the most powerful motor refrigerator ship afloat. At Dumbarton a single set of Denny-Sulzer engines was built by William Denny and Brothers, Ltd., and was put into the cargo vessel Yomah. Progress with this same type of machinery was made by Sir W. G. Armstrong, Whitworth and Co., Ltd., at Newcastle, and five sets of engines were built for the three locomotive-carrying vessels constructed by Sir W. G. Armstrong, Linthouse, was fitted with single-screw airless injection two-cycle machinery of 400 S.H.P. Twin-screw engines of similar design, with a total output of 600 S.H.P., were fitted into the motor yacht Vita, built by Camper and Nicholson, Ltd. The vessel Kybra of some 890 gross tons, built by the Coaster Construction Company, Ltd., of Montrose, was also equipped with single-screw standard Sulzer engines, designed for an output of 780 S.H.P. G. and J. Weir and Co., Ltd., of Cathcart, completed some oil engine driven auxiliaries. At the Wallsend yard of Swan, Hunter and Wigham Richardson, Ltd., the molasses tanker Athelking, for the British

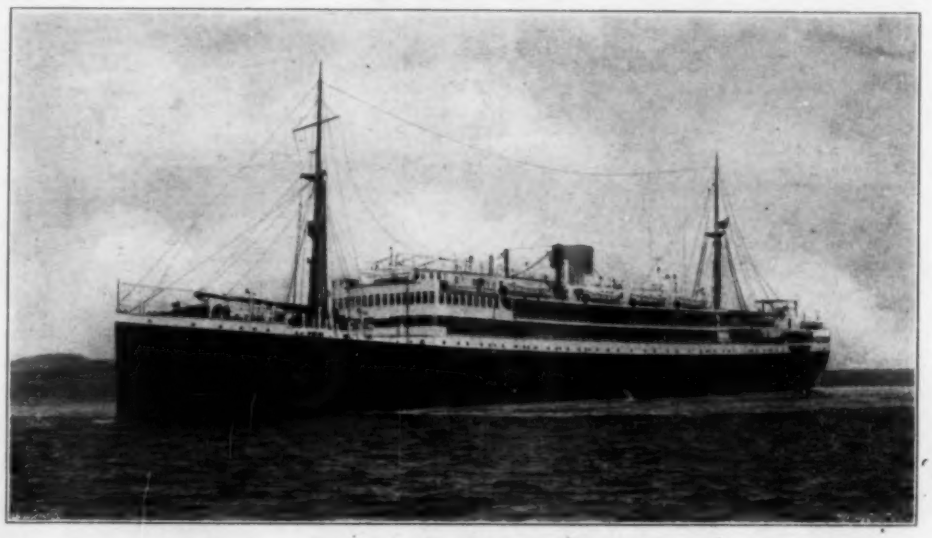


FIG. 1—THE ELDER DEMPSTER LINER ACCRA

SOME MARINE OIL ENGINES OF 1926

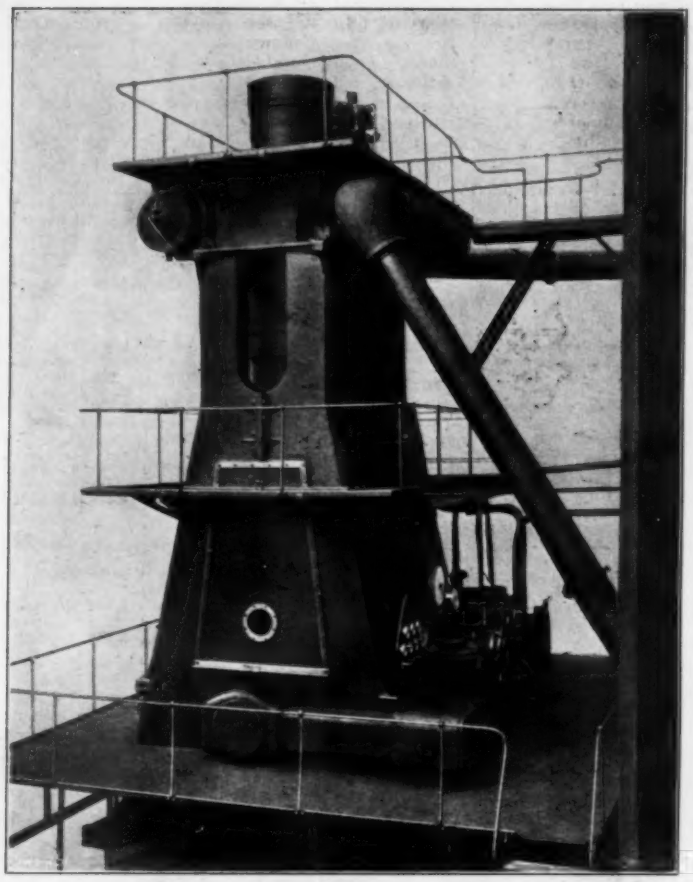


FIG. 2—THE RICHARDSONS, WESTGARTH DOUBLE-ACTING ENGINE

FIG. 3—THE PLENTY-STILL OIL ENGINE

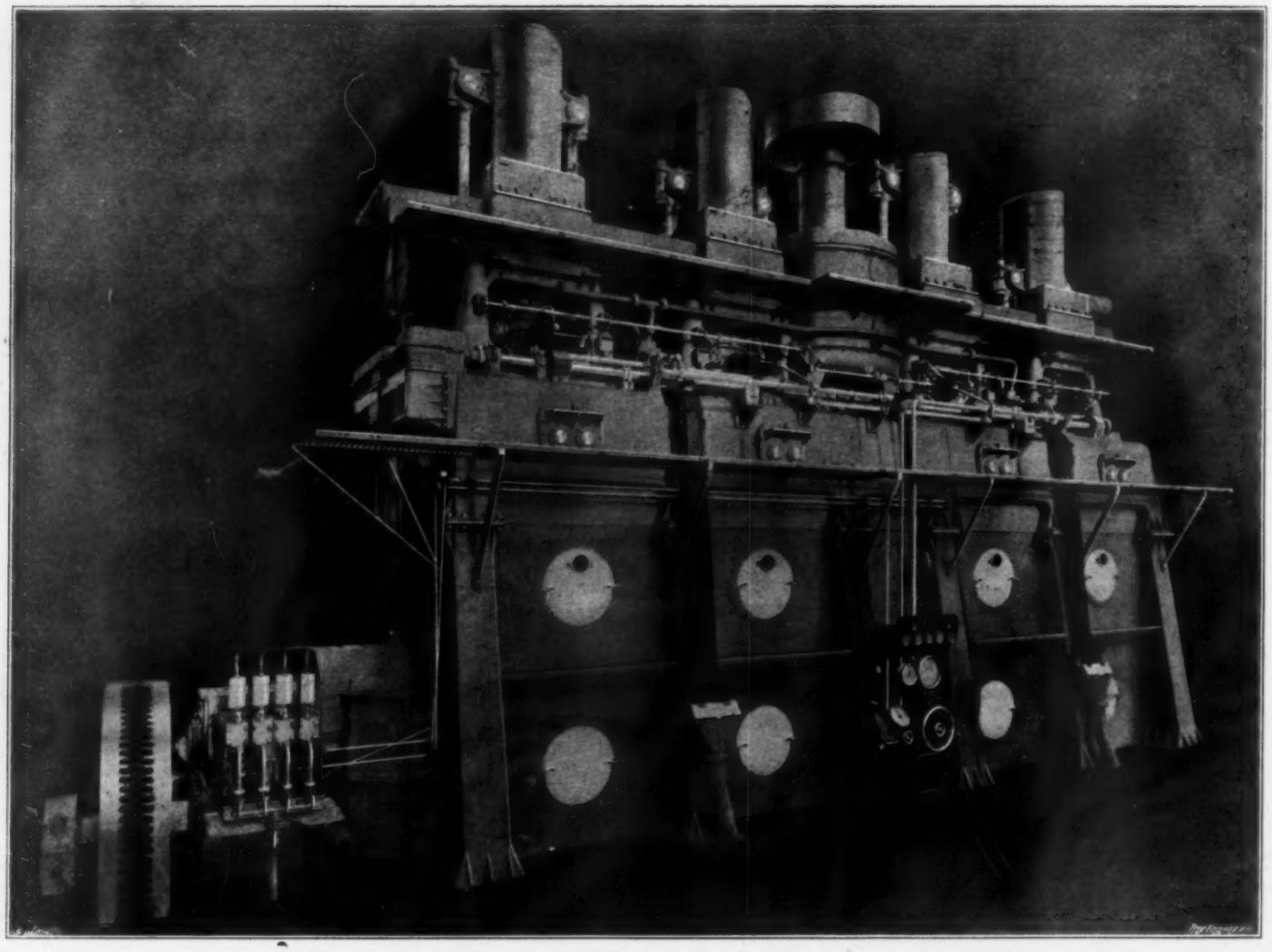


FIG. 4—DOXFORD FOUR-CYLINDER OPPOSED-PISTON AIRLESS-INJECTION OIL ENGINE

Molasses Company, Ltd., London, was completed and equipped with twin-screw Neptune oil engines, of 4000 S.H.P. We also give particulars of the converted steamship Black Sea, in which a four-cylinder two-cycle oil engine of the Burgerhout-Nobel type, referred to in our last year's annual article, was installed. The set of Nobel type engines, and referred to in last year's annual article, built by Mirrlees, Bickerton and Day, Ltd., of Hazelgrove, Stockport, will be used in a power station at Worthing.

Although no ships fitted with Still engines were finished during the year, some advance is to be recorded in connection with this interesting type of prime mover. The Scott-Still vessel Dolius did good work during the year, and maintained her high overall efficiency. At the Greenock yard of Scott's Shipbuilding and Engineering Company, Ltd., good progress was made with the 4000 S.H.P. Scott-Still machinery which is ordered for a new Holt ship. The twin-screw engines mark a departure from previous practice in that each engine will have seven cylinders, of which five will be single-acting two-cycle oil engine cylinders of 27in. diameter, and two double-acting steam cylinders of 24in. diameter, with a common stroke of 45in. and a normal speed of 100 r.p.m. The steam raised in the jackets of the oil engine cylinders will be employed for auxiliaries, and in the steam cylinders referred to. It is understood that the new design offers certain manufacturing advantages. At the Newbury works of Plenty and Son, Ltd., an experimental oil and steam engine operating on the Still principle was built and tested. It is, as is shown by our illustration, Fig 3, opposite, a single 370 mm. by 450 mm. cylinder unit. At a designed speed of 250 revolutions per minute, it develops 130 to 150 B.H.P. Sufficient steam is generated to maintain a steady pressure of 150 lb. in the boiler, and the trials showed that the combustion cylinder gives on full load a mechanical efficiency of about 78 per cent., which is increased to approximately 97 per cent. when the power delivered from the steam side of the piston is added. The engine was designed for trawler work, for which it is specially suited, because of its excellent manœuvring qualities and high economy.

Opposed-piston Engines.

In Fig. 4, opposite, we reproduce an illustration of the four-cylinder Doxford opposed-piston oil engine working with airless injection, which is to be fitted to six ships of the Silver Line, Ltd. Particulars of two vessels, the Silverash and Silverbeech, which were finished during 1926, are given in Table II., and in one of to-day's Supplements we show the Silverash. The Doxford engine bears the distinction of being the highest powered British engine, developing, as it does, 1250 S.H.P. in each cylinder at the low running speed of 90 r.p.m. The makers have secured several recent orders, including engines for passenger-carrying ships. We also include in our table particulars of the single-screw vessel Tynefield, which has Doxford engines and is a sister ship to the Sylvafield, mentioned in our returns for last year.

Some New Directions of Development.

Apart from the general trend of design in the direction of simplified construction and larger outputs, which at no distant date seem likely to approach 2000 I.H.P. per cylinder, we have to note several efforts to utilise engines of higher speeds. Of necessity such development will be restricted at first to units of small and moderate powers. Noteworthy among such installations was the machinery for the tug Southland, built by Vickers-Ireland, Ltd., for the Bluff Harbour Board of New Zealand and engined by Vickers-Petters, of Ipswich, with two 600 B.H.P. engines running at a speed of 270 r.p.m. We described this installation in our issue of October 15th. Another high-speed engine of the year was the Mumford oil engine, an illustrated account of which will be found in our issue of December 3rd. It is a four-cylinder engine of extremely light weight, designed and built by A. G. Mumford, Ltd., of Colchester. The cylinders have a bore of 5½in. with a 9in. stroke, and the set is designed for an output of 120 B.H.P. at a maximum speed of 1100 r.p.m. The engine was tested under running conditions with various fuels by Mr. W. A. Tookey. Quite early last year Mr. Alan E. Chorlton gave particulars, in a paper read before the Institution of Mechanical Engineers of a high-efficiency, quick-running oil engine designed by William Beardmore and Co., Ltd., which has been used successfully for railway work. Two twelve-cylinder vee type engines with an output of 1500 H.P. each are now under construction for an oil-electric locomotive, and plans are being considered for a marine unit which will combine two such engines with reduction gearing, all mounted on a common bed-plate. Such an engine would have four lines of cylinders—thirty-six in all—arranged in two vees and working on to two crank shafts, and would be capable of giving an output of 4500 S.H.P. The weight of the complete unit would, we learn, only be about 60 tons.

Another direction in which progress was made is in the better utilisation of the heat of the exhaust gases for the production of hot water and steam. Exhaust gas boilers were fitted to several ships. In this connection we may refer to the Clarkson thimble-tube boiler fitted to the motor vessel Malabar, which has now been in service some fourteen months and is working in connection with Kincaid-B. and W. four cycle, single-acting engines developing about 2700 S.H.P. Steam is raised at a pressure of 100 lb. per square inch, an auxiliary oil burner being fitted for use in port. The Clarkson Thimble Tube Boiler Company, Ltd., has now under construction several waste heat boilers designed to work with engines up to 4000 S.H.P., operating both on the two and four-stroke cycles. In the case of the two-cycle engines the fitting of an exhaust boiler has in certain cases improved the fuel consumption, presumably because of the better scavenging effect obtained by the sudden cooling of the gases in the boiler system.

In the year which has just passed more attention was given to the question of the production of sound castings for marine oil engines. Some firms, notably Vickers Ltd., the North-Eastern Marine Engineering Company, Ltd., and Burmeister and Wain, Ltd., of Copenhagen, have adopted the Lanz process for the production of pearlitic iron by careful cupola and mixture control. The revived interest taken in foundry practice has led to greater appreciation of the metallurgical aspects of oil engine design, so that the production of high-grade castings is now receiving the attention it merits.

Smaller Marine Motors.

On the whole, builders of small and medium-power marine motors were well employed during the year, and a large number of British engines were fitted for yacht and boat propulsion and used on liners for motor lifeboats and emergency generating sets. In our issue of April 9th we illustrated one of two characteristic six-cylinder engines built by L. Gardner and Sons, Ltd., of Patricroft, Manchester, for a private yacht. It was designed for an output of 300 B.H.P. and for working with "gas oil" fuel. In the same issue an account was given of trials run on a standard four-cylinder 65 B.H.P. motor constructed by the Parsons Oil Engine Company, Ltd., of Southampton, and fitted with a special vaporiser for "gas oil." Several engines of this type were built. The Ailsa Craig Motor Company, Ltd., of Strand-on-the-Green, Chiswick, has again increased the range of its standard marine motors. Its programme now embraces engines from the twin 4 to 6 H.P. unit up to the six-cylinder engine designed for an output of 60 to 100 H.P. We understand that the past year was marked by an increased demand for six-cylinder engines. In several cases reduction gears were fitted in order to give low propeller speeds, and in this connection we may mention the "Titan Special" gear designed and built by the Langdon Engineering Company, Ltd., of Southampton, which was described in our issue of June 11th. In September an event of interest in the fishing industry took place when trials were made on the motor drifter Veracity, which was built by S. Richards and Co., Ltd., of Lowestoft, and engined with a Deutz-Richards four-cylinder 200 B.H.P. airless injection engine. Another interesting small motor vessel of the year was a ferry boat for the Port of London Authority, which is fitted with a Gill axial flow propelling pump, driven through a friction clutch by a petrol motor. The boat showed the remarkably easy manœuvring which is associated with that system of hydraulic propulsion. The firm of John I. Thornycroft and Co., Ltd., reports a substantially increased output of marine internal combustion engines compared with 1925, and some 70 per cent. of the constructed engines were for countries abroad. About fifty yachts and launches of various types were built at the firm's Hampton yard and the engine output amounted to a total of 13,000 B.H.P.

Progress in Europe and America.

The past year was one of marked activity in motor shipbuilding in all European shipbuilding centres. In what follows we can only indicate in brief outline the progress made.

Germany is again to the fore and is second in output as regards to motor ship construction. During 1926 the five 10,000-ton 14½-knot vessels ordered by Furness, Withy and Co., Ltd., from the Deutsche Werft at Hamburg were delivered. They are engined with eight-cylinder twin-screw A.E.G.-B. and W. type motors and several interesting auxiliary devices, including A.E.G. steering gears, are fitted. The shipbuilders report a serious loss over this order, which, it will be remembered, was the cause of the setting up of a joint inquiry into the British shipbuilding industry. Several M.A.N. type engines were completed for Germany and other countries. In our issues of March 26th and April 12th we described in detail the tests of a six-cylinder, 4400 B.H.P., double-acting, two-cycle M.A.N. engine which was built at Augsburg. Two Weser-M.A.N. engines of a little over 1000 S.H.P. total were installed in the rotor ship Barbara, a geared arrangement of single screw machinery being employed. Several interesting tests were made, both with and without the rotors in operation. The ship, see Fig. 6 on page 12, and her machinery was described in our issue of October 15th. Further interest in the M.A.N. double-acting engine was aroused by the installation in the Hamburg Neuhof power station of a nine-cylinder unit designed to develop 15,000 B.H.P. at 95 r.p.m. That engine also was illustrated and described in our issue of June 25th.

A new type of two-stroke cycle double-acting engine was built during the year at the Fried. Krupp Germaniawerft, Kiel-Gaarden. It was designed for an output of 1800 I.H.P. in a single cylinder, and we described and illustrated it in our issue of November 19th. A feature of several German-built motor ships was the use of high-pressure supercharging, the blowers in some cases being driven by exhaust gas turbines.

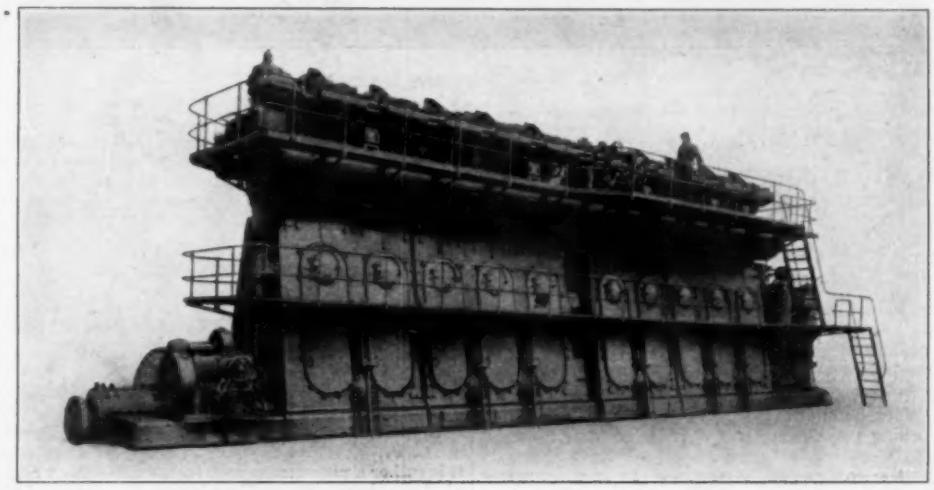


FIG. 5—TEN-CYLINDER SULZER ENGINE FOR THE CHRISTIAAN HUYGENS

Denmark again occupied a prominent position in motor shipbuilding, being third as regards world's output. At Burmeister and Wain's works no less than twenty sets were completed, of which five were for British-built vessels. Among the seven ships built by Burmeister and Wain we may refer to the Danmark, a 460ft. vessel of 12,400 tons, belonging to the East Asiatic Company. She is the largest funnel-less motor ship afloat and is engined with two standard six-cylinder motors. Another interesting ship is the Jylland, a sister vessel to the Parkeston, which was put on the Harwich-Esbjerg run. The high-speed trunk piston engines fitted in this ship are provided with a supercharging arrangement. It is worthy of note that at the end of 1926 a total of 278 ships carrying 2,233,486 tons deadweight and equipped with engines of 913,865 I.H.P. are engined with B. and W. type motors made by the parent firm and its various licencees.

At the Götaverken, Gothenburg, Sweden, five motor ships were launched and seven sets of B. and W. type engines built, besides twenty-one auxiliary engines. Progress was also made with the Polar design of engine, and a new six-cylinder 2000 B.H.P. unit was designed and built for the motor tanker Sommerstad. A smaller 720 B.H.P. engine of the same pattern was supplied to Bow, McLachlan and Co., Ltd., of Paisley, for installation in the coasting vessel El Amin.

Passing to Holland, we again have to record an interesting advance. A recent event was the sailing of the Phobos, the first of the series of 10,000-ton oil tankers, ordered by the Anglo-Saxon Petroleum Company, Ltd., of London, which are to be fitted with 3500 S.H.P. Werkspoor double-acting four-cycle engines. The engine of the Phobos is the first double-acting motor to be built at the Werkspoor Engine Works in Amsterdam. It has a rotary valve arrangement, and throughout the trial it ran, we learn, remarkably well. A great advantage of the new valve gear proved to be the ease

in dismantling it and getting at the interior of the cylinders. A two-stroke double-acting engine is also under construction at the Werkspoor Factory, and will be ready for testing early this year. Another motor ship engined by Werkspoor which, like the Phobos, was built by the Netherland Shipbuilding Company, was the twin-screw vessel Cremer, built for the Royal Dutch Packet Company's Eastern service. Another Dutch ship was the Van Heutz, which was built by the Royal Schelde Shipbuilding Company, of Flushing, and is equipped with Sulzer type engines.

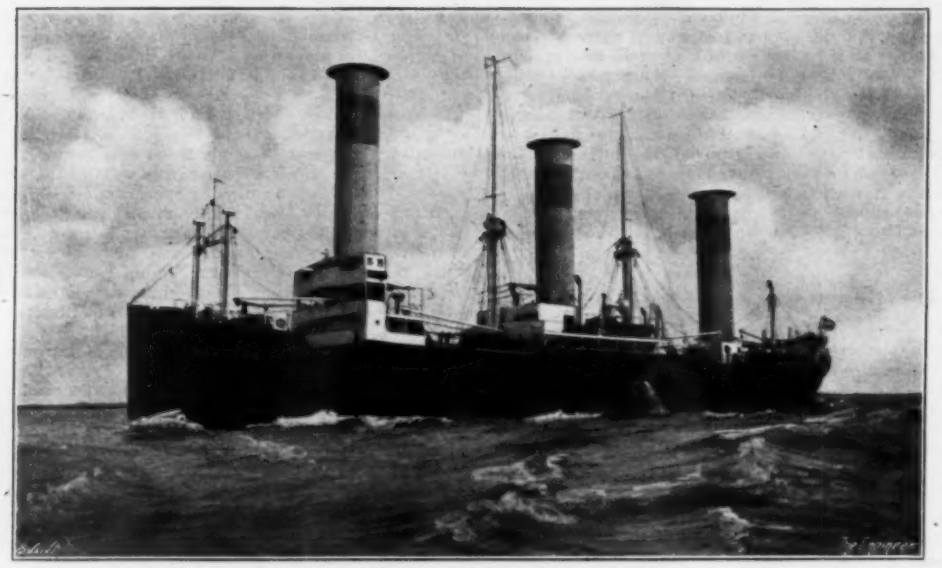


FIG. 6—THE MOTOR SHIP BARBARA

An important Dutch motor vessel of the year was the P.C. Hooft, built for the Netherland Steamship Company by the Ateliers et Chantiers de la Loire at St. Nazaire, France. She is fitted with twin-screw eight-cylinder Sulzer engines, designed for a total of 8000 S.H.P., at 95 r.p.m. A second larger liner for the same company is under construction in Holland. It is named the Christiaan Huygens, and has a length of 570ft. Two Sulzer engines, with an output totalling about 11,600 S.H.P., are to be installed. We illustrate one of these ten-cylinder units in Fig. 5 on page 11. Another Dutch tank ship, the Woensdrecht, was engined with Fyenoord-M.A.N. propelling machinery, and during the year arrangements were made for Wiltons', of Rotterdam, to build the Krupp type of engine. In France, motor ship development though long delayed, has now been begun. Early in 1926 the General Gassouin, a 6000-ton oil tanker for the French subsidiary of the Standard Oil Company, was completed and equipped with 1850 B.H.P. Sulzer type engines. In November last the first French motor liner, the Théophile Gautier, a twin-screw liner of about 9000 tons, with French-built Sulzer type engines of 4500 B.H.P., was commissioned for the service of the Messageries Maritimes.

In the revival of shipbuilding which has taken place under State protection in Italy, the motor vessel has played an important part. Probably there are no works in which standardisation is carried further than the Stabilimento Tecnico Triestino Yard at Trieste. Over eleven standard motor vessels, fitted with Burmeister and Wain type motor, were completed during the year and within a few months the large liners Saturnia and Urania will be finished. Marine oil engines have also been constructed at Tosi's Legnano works and at the Fiat Factory in Turin. At the latter works two sizes of four-cylinder engines are built for outputs of 2200 and 1600 B.H.P. respectively. These engines are noteworthy for the heavy overloads which they are capable of carrying. In December last the largest motor ship in the world, the Augustus, was launched from the Ansaldo Yard at Sestre Ponente, near Genoa. She has a displacement of 32,000 tons, and with quadruple screw M.A.N. double-acting engines, aggregating some 40,000 S.H.P., a speed of over 20 knots is to be attained. Italy's motor shipbuilding programme is one which next year will put her in the forefront of progress. In America, several smaller vessels, and about nine larger ships of various types were completed. The chief interest centred around the "Dieselization Programme" of the United States Shipping Board, under which scheme it is proposed to convert twelve steamships, which will, when completed, form the nucleus of a fleet of fifty motor vessels under the ownership of the Board. The first ship so to be converted was the Tampa, in which a Worthington double-acting two-cycle motor was installed. The engine, which was designed and built at the Snow Holly Works of the Worthington Pump and Machinery Corporation, Buffalo, N.Y., is a four-cylinder unit with 28in. by 40in. cylinders. It is designed for an output of 2950 S.H.P., at 95 r.p.m., and it developed 3980 I.H.P. at sea. The Tampa made her first trip to Bremerhaven early in December, and a full account of her successful maiden voyage results was given in our last issue. The design of the engine was described in our issue of October 3rd, 1924, and its tested trials on April 23rd last. It is noteworthy that the engine was designed by Mr. O. E. Jorgensen, an engineer well known in Copenhagen and Glasgow in connection with the early development of the Burmeister and Wain motor. The design is one which should go far by reason of its simplicity. It will probably be built both on the Continent and in Great Britain, the British rights for manufacture being in the hands of the Worthington-Simpson Company, Ltd., of London.

Physical and Optical Societies' Exhibition.

No. I.

IN view of the interesting and instructive character of the Physical and the Optical Societies' Exhibition, it is rather a pity that it only lasts for the short period of three days. From Tuesday to Thursday of this week an excellent display of scientific apparatus remained on view, but it is well within the range of possibility that the Exhibition would have continued to draw visitors if it had remained open until the end of the week. During recent years the Show has become more attractive than it was in bygone days, when, relatively speaking, manufacturing firms paid little attention to research, and when the manufacture of wireless and other electrical apparatus had not developed to anything like the same extent as it has to-day. The Exhibition has, in our opinion, now become an event of considerable importance, for in these times of rapid electrical and general scientific development new things are constantly being produced and a display of the latest scientific apparatus every year is, to say the least, desirable. On this occasion there was much to be seen that is new, and as on previous occasions, electrical apparatus was well to the fore. A notable feature of the Exhibition was a display of models for educational purposes, some of which were recently described in THE ENGINEER; another praiseworthy feature being a good display of apparatus by the research departments of various firms and the National Physical Laboratory.

The L.M. Magneto Syndicate, Ltd., of Coventry, was exhibiting peak voltage measuring instruments designed for the measurement of the maximum or peak values of the voltages occurring in electrical systems, and particularly when such peak values take the form of impulses of relatively short duration, as compared with the time intervals which separate them. Under such conditions, the energy available at the moment of occurrence of the impulse is usually small, and it is important that the capacity and energy consumption of the measuring apparatus shall be reduced to a minimum, so as to avoid disturbing the characteristics of the circuit to which it is connected. Two forms of apparatus were shown, one suitable for impulsive pressures up to 300 volts, the other for voltages from 2000 and 15,000 volts. Both forms employ in the first instance a two-electrode rectifying valve and a small condenser. The condenser is charged up through the valve to the maximum voltage occurring in the circuit to which it is connected, and the voltage across this condenser is then measured. As electrostatic voltmeters of the ordinary type are not suitable for use in portable apparatus, this measurement is effected in the first type of apparatus by sharing the charge of the small condenser with a larger one, which controls the grid potential of a three-electrode valve. Measurement of the current in the plate circuit with a definite plate potential, gives the grid potential, and hence the potential to which the condenser has been charged. In the second type of apparatus the condenser is shunted by a calibrated spark gap between two brass balls, 20 mm. diameter. One of the balls is fixed, whilst the other is adjustable through the medium of a cam fixed on a shaft, which also carries a graduated dial. By suitably shaping the cam even calibration of the dial is obtained. Each type of apparatus is mounted in a wooden case about 9in. cube, which also contains the accumulator for supplying the filament, and in the first type of apparatus a small motor generator for supplying the plate current.

An apparatus for observing flaws in metal surfaces and comparing the conductivities of metal plates was exhibited by Professor E. W. Marchant and Mr. J. L. Miller. The apparatus consists of a special normally balanced bridge network with two inductive arms. The bridge is supplied with alternating currents, the indicating instrument being a direct-current galvanometer connected to it through a synchronously driven commutator. One of the arms of the bridge consists of an exploring coil, which is placed on the metal surface to be examined. If the commutator is set in the "in phase" position, the galvanometer deflection is proportional to the change in effective resistance of the exploring coil. If there is a surface flaw in the metal, the eddy currents produced in it are checked and the change in effective resistance of the coil is altered, the deflection caused by the metal plate being reduced to a minimum when the centre of the coil is over the crack. By moving the coil over the surface it is possible to detect minute cracks in the metal and to find where they are, and this may be done equally well with non-magnetic metals and with magnetic metals. The apparatus may also be used for quickly comparing the specific conductivities of metal plates. When used for this purpose, it is best to set the brushes in the "out of phase" position, in which case the deflection is proportional to the change in effective inductance of the plate. The change in effective inductance of the plate is a complex function of its thickness and specific resistance, but for very thick plates the galvanometer deflection is approximately proportional to the square root of the specific conductivity.

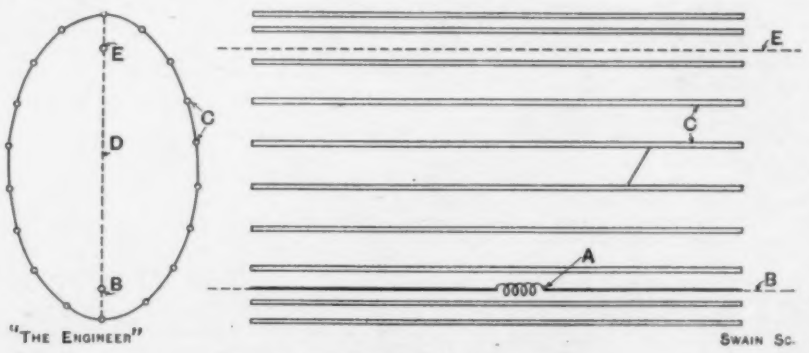


FIG. 1—GALLETTI RADIO BEAM TRANSMITTER

A notable feature of the Exhibition within recent years has been a good display of wireless apparatus, which is maintained on the present occasion. H. Tinsley and Co., of South Norwood, were showing a model of Mr. Galletti's radio beam transmitter. The actual transmitter is at Hendon, but the model illustrates the principle on which it works. It is capable of sending out an actual beam of radiation exactly like a searchlight, and not in the same way as the angular wedges of radiation are sent out by the beam stations at present working. The beam can be directed on a given target and be limited, both vertically and horizontally, the angle of the beam being negligible. The actual transmitter at work at

Hendon is operating with 4 m. waves, but the wave length could be varied without affecting the general principle. The scheme will be understood from the diagram, Fig. 1, reproduced from Mr. Galletti's patent specification. An open Hertz oscillator A or equivalent generator of wireless waves is situated in one focal line B of an elliptical barrel formed by staves of straight wires C, parallel to one another and having the same periodicity as the oscillator. The sum of the vector radii of the ellipse, viz., the major axis D, is made equal to half the wave length generated, i.e., $\frac{\lambda}{2}$, or a multiple thereof. Under these conditions an image is produced in the second focal line E, and by making the ellipse fairly elongated the field produced between the oscillator arranged in the focal line B and the image produced in the line E is practically a cross. The magnetic lines do not close round the oscillator, but are reflected at the elliptical surface. Each ray travelling through the foci and reflected within the ellipse finally lapses on the major axis, where all the rays continue to pulsate up and down along this axis until their energy is radiated through the ends of the barrel. The electromagnetic waves are propagated along a beam in the longitudinal direction of the barrel, the energy being more concentrated along the plane containing the focal lines, the highest concentration being along a ray forming a continuation of the focal line B. The elliptically arranged staves may be used horizontally, vertically or at any desired angle, and a second radiating oscillator may be placed in the focal line E, and be so energised that its phase is 180 deg. in relation to the first oscillator. The natural frequency of the staves of straight wires is made to correspond to half the wave length propagated, viz., $\frac{\lambda}{2}$, or a multiple thereof.

The Midworth distant repeater exhibited by Eversbed and Vignoles, Ltd., of Acton, enables movements as different in character as the motion of a sluice gate, lever arm, or instrument pointer to be shown at a distance and at any number of points, whilst it can also be used for the distant control of any power-driven apparatus. The system involves the use of a transmitter actuated by the mechanical or electrical movement it is desired to repeat, and any required number of repeating instruments, either indicating, recording, integrating, or controlling. Actually the transmission is of an angular motion, which the repeating instruments show by a corresponding angular deflection. When a movement in a straight line is to be repeated it is therefore converted into an angular motion, but, if it is desired that the original movement shall be repeated exactly, appropriate arrangements can be made at the repeating station. Various advantages are claimed for the system, one being that it imposes no load on the apparatus of which the movements or indications are to be indicated or recorded—a valuable feature when the readings of a delicate instrument have to be transmitted to a distance. Another feature to which the makers direct particular attention is that the system does not operate on the step-by-step principle and the repeating instruments cannot get out of step with the transmitter. When the system is used for transmitting information by means of indicating or recording instruments it requires only two conductors between the transmitter and repeating instruments. Variations in the supply voltage and changes in the resistance of the repeater circuit are automatically compensated for, with the result that the line connecting the transmitter and repeating instruments may be of any desired length. The number of repeating instruments may also be varied at will without affecting the accuracy of the system. In the event of a breakage in the line the apparatus returns automatically to normal working when the break has been repaired, the original accuracy of the system being immediately restored. When the apparatus is used for transmitting indications or signals a large number of repeating instruments may be used without materially adding to the expense of the equipment, the repeating instruments being milli-ammeters. There are many uses to which the system may be put, for it can be used to transmit accurate quantitative information or for the sensitive control of apparatus situated at any distance from the transmitting station. The apparatus is, moreover, simple and compact and requires very little attention.

The principle underlying the system is the regulation by the originating movement of an electric current which passes through the controlling and repeating instruments in series. The regulation is such that a definite current corresponds to every stage of the originating movement, quite independently of the voltage or resistance of the circuit. The transmitter illustrated in Fig. 2 consists of a main index operated by the originating movement, an electrical control instrument, and the control mechanism. Whenever the main index of the transmitter is moved it carries with it the pointer of the electrical control instrument and sets in motion the control mechanism, which adjusts the current flowing in the repeater circuit to the value corresponding to the new position of the main index.

Below the main index and in axial alignment with it is the pointer of the electrical control instrument, which floats between two contacts on the main index, and, when the latter moves in response to the originating movement with which it is connected, one of the contacts which it carries touches the pointer of the control instrument and completes the circuit of one of the field coils of the control motor. On being energised the field coil closes a switch in the armature circuit of the control motor, at the same time releasing a brake which normally prevents the armature from revolving.

The armature of the control motor then turns and by means of worm gearing moves the contactor arm over the control rheostat shown in the drawing Fig. 2. The direction in which the contactor arm is moved depends on which field coil has been energised, which is determined by which contact has been touched by the control pointer. As the contactor arm moves over the rheostat the current passing through the repeater and control instrument is altered, and this change continues until the pointer of the control instrument reaches a position at which it floats freely between the contacts carried by the main index. As the control pointer then no longer touches either contact of the main index, the field coil circuit is broken, the motor circuit is opened and the motor is stopped instantaneously by the brake. Thus the control mechanism operates to bring the current passing through the control instrument to such a value that the angular deflection of the instrument corresponds with that of the main index, the pointers of the control instrument and main index being in alignment. For a given position of the main index this current must have a definite value, so that the position of the main index governs the current through the controlling instrument and repeater circuit. As the control and repeating instruments are in series, the pointers of the repeaters will give indications corresponding to that of the control instruments. Moreover, as the operation of the control mechanism always tends to bring the system to a state of balance with the control instrument and the main index in alignment and the motor at rest, it is evident that when the state of equilibrium is attained there can be no load on the main index; hence the system can be used for repeating the indications of delicate instruments at a distance.

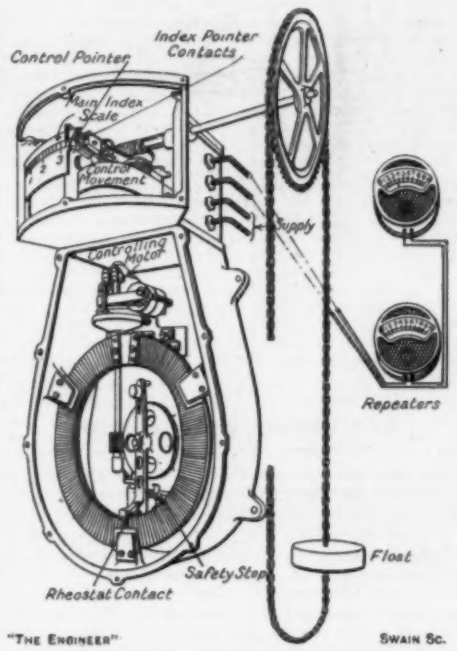


FIG. 2—MIDWORTH DISTANT REPEATER

As mentioned at the outset, the apparatus automatically compensates for voltage variations. If, for instance, the voltage drops, the current in the repeater circuit falls and the pointer of the control instrument will touch one of the contacts on the main index. The motor will then start and will rotate the rheostat contactor in the direction necessary to increase the current through the repeater circuit, and this operation will continue until the current has been restored to its correct value and the control pointer once more floats freely between the two contacts of the main index. As changes in the resistance of the repeater circuit have an effect on the current similar to variations in the supply voltage, they are similarly compensated for, and as the insertion or removal of additional repeating instruments merely corresponds to the insertion or removal of resistance in the repeater circuit, it is evident that the number of repeating instruments can be varied at will without affecting the accuracy of the system. In the event of a break in the line connecting the transmitter and repeating instruments the control motor is set in motion, and it will tend to make up for the insertion in the circuit of a resistance of infinite value, the rheostat contactor being rotated until a safety contact is reached. This safety contact is arranged so that when it touches the rheostat contactor the field coil that is energised at that moment, i.e., the field coil which causes the motor to turn so as to increase the current in the repeating system is switched off, and the system is closed down. The circuit through the other field coil, which causes the motor to turn the contactor arm so as to reduce the current, is, however, left ready for completion, and when the normal conditions of the line are restored the motor immediately starts up and the instrument readings assume the correct value. A similar safety contact is provided to prevent damage in the event of the contact arm carrying the main index being accidentially carried below its zero position, and in this event the apparatus is also closed down until normal working conditions are resumed.

The efficiency of the internal contacts does not affect the proper working of the system, for in the event of the rheostat or contactor becoming dirty or corroded, the rheostat arm is caused to oscillate until the dirt or oxide has been removed. Thus the rheostat is self cleaning. Moreover, the contacts of the main index only carry the small current necessary to energise the field coils and are not therefore subjected to sparking or to rapid wear. As the full-line voltage is always across the contacts they are not susceptible to failure and all the contacts are readily detached. The motor used is of very simple design and its consumption is small; the entire installation only using from 10 to 12 watts. There are many uses to which the system may be put, but unfortunately limitations of space will not allow us to deal with them.

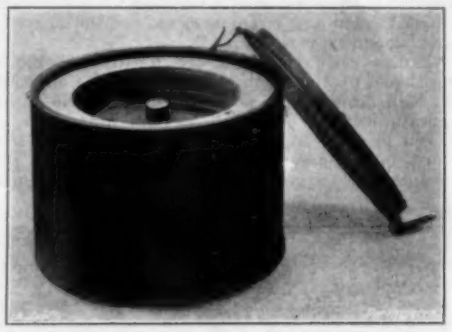


FIG. 3—SCHERING GALVANOMETER

The Schering vibration galvanometer, exhibited by the Cambridge Instrument Company, Ltd., and shown in Figs. 3 and 4, is of the type originally evolved by Schering and Schmidt and is manufactured in accordance with designs furnished by the National Physical Laboratory. It is particularly suitable for use in conjunction with the Schering bridge method of measuring power losses in dielectrics and for precision measurements on standard condensers. The instrument is tuned by varying a small direct-current polarising current which can be supplied by two or three small accumulators. If required, the instrument, battery and adjusting resistance can be at a high potential above earth, the resistances being operated by an insulating handle. Since the alternating current circuit of the galvanometer is fixed, and is not limited as to size and inertia, as it is in the case of a moving coil vibration galvanometer, a large number of turns of fine wire may be used, which is an advantage when measurements on circuits of high impedance are to be made. The galvanometer can be used for frequencies between 25 and 120 periods per second.

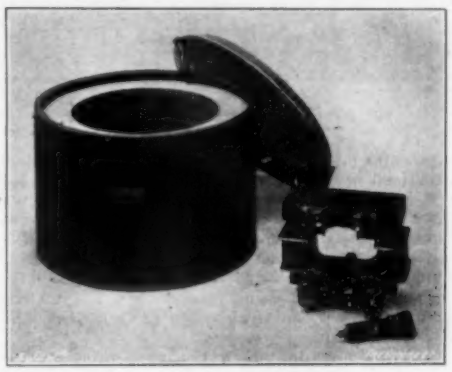


FIG. 4—SCHERING GALVANOMETER

The instrument consists of a small U-shaped magnet made up of three pieces for providing the polarising field, and two other magnets, the pole tips of which are made to form radial arms about the vibrating system. The polarising flux passes through these two latter magnets. The polarising winding is wound on the two main limbs of the uprights, forming the arms of the U magnet, and the measuring windings, which consist of four small bobbins, are mounted on the limbs of the two small magnets. The effect of an alternating current flowing in these small magnets is to distort the field by moving it through an angle, first in one direction and then in the other on either side of the neutral position. The vibrating system consists of a small piece of thin soft iron suspended by a light phosphor-bronze strip which is anchored

at both extremities and which carries a plane mirror. The vibrating system is contained in a metal case of tubular form in which is fitted a lens of about 1 m. focal length, and the unit can easily be removed from the main instrument. In order to make the oscillations of the needle visible a beam of light is focussed on to the needle mirror and reflected on to a ground glass plate with graduated divisions. Provision is made whereby the earth capacity of the instrument is reduced to a low figure. The galvanometer is protected from magnetic fields by means of a heavily laminated shield, as shown in the illustrations. The galvanometer possesses the following advantages :—(1) It is a moving iron instrument and is therefore very robust ; (2) it may be tuned from a distance by the simple expedient of varying the intensity of a direct-current electro-magnetic field ; (3) it is protected from the effect of external stray magnetic fields ; (4) the earth capacity of the apparatus is very low ; (5) provision is made for damping the movement, and the degree of damping can be varied.

The dissolved oxygen apparatus, illustrated in Fig. 5, also shown by the Cambridge Instrument Company, has been designed for the purpose of providing an accurate method of measuring the proportion of oxygen in the feed water entering boilers. It is a robust boiler-house instrument, which records the percentage of oxygen on a chart calibrated in cubic

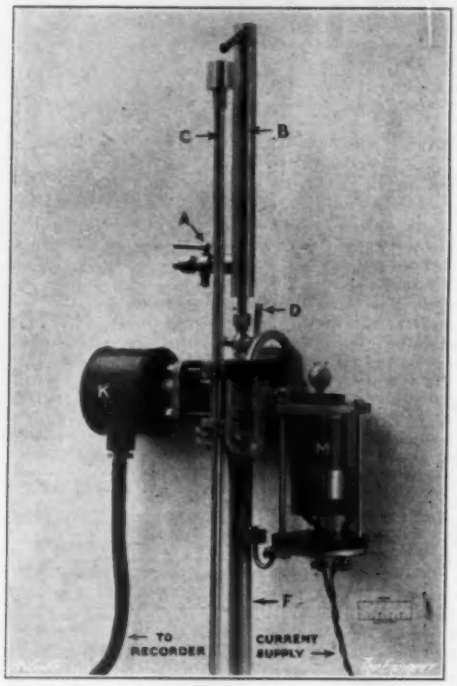


FIG. 5—DISSOLVED OXYGEN APPARATUS

centimetres per litre of water, and it enables defects in the feed water to be instantly detected. The full-scale deflection on the chart corresponds to one cubic centimetre of oxygen per litre, although for efficient working of the plant the record should not show more than one-tenth of that value. The apparatus may be arranged to operate an electric device, which will ring a bell, light a signal lamp or operate a Klaxon horn when the percentage of dissolved oxygen rises above the critical figure.

The principle on which the apparatus operates is simple. A small quantity of water from the feed system is passed at a constant rate through a tower fitted with extraction rings, where it is scrubbed by a constant flow of pure hydrogen generated electrolytically. The hydrogen mechanically displaces the dissolved oxygen in the feed water and the relative rates of flow of hydrogen and water are so arranged that the displaced gas forms a considerable percentage of the total gas issuing from the top of the scrubber, this percentage being measured by means of a katharometer and is shown on the chart of the recorder. The katharometer contains two identical spirals of platinum wire enclosed in separate cells in a metal block, and the spirals are connected to form two arms of a Wheatstone bridge circuit. When an electric current flows in the circuit the spirals become heated and give up heat to the walls of the cells, their temperatures, and in consequence their resistances, depending on the thermal conductivity of the gases surrounding them.

One of the cells is exposed to the pure hydrogen passing from the electrolytic supply, whilst the other cell of the katharometer is exposed to the gas after it has passed through the scrubber tower. Owing to the presence of the oxygen from the feed water, the thermal conductivity of the gas in the second cell of the katharometer is different from that of the other cell, with the result that the Wheatstone bridge circuit is thrown out of balance, thus producing a deflection of the galvanometer, and the extent of this deflection gives an indication of the amount of oxygen present in the second cell.

The katharometer, the electrolytic cell and the scrubber tower are shown in Fig. 5, whilst Fig. 6 shows a diagrammatic arrangement of the complete outfit. The feed water is led from the high-pressure source of supply through a needle valve to the inlet cock A and into the constant head device B, which is arranged to keep the water supply constant without exposure to the air by the overflow C. The flow through the scrubber is regulated by the cock D to about 500 c.c. per minute. The hydrogen is generated in the cell M by a current of about 1·4 ampère, which may be obtained either from a direct-current supply regulated by a resistance or from a rectifier, when the supply is an alternating current one. The whole of the hydrogen generated passes across one cell L_1 of the katharometer K and then through the tube J to the bottom of the scrubber tower F, and on leaving the top of the scrubber it passes across the second cell L_2 of the katharometer and out to the air. The katharometer is connected by leads shown in the left

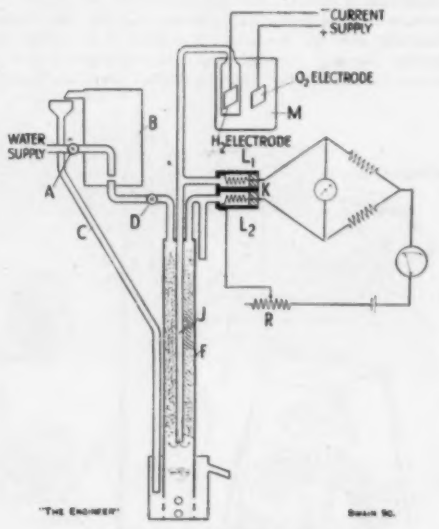


FIG. 6—DISSOLVED OXYGEN APPARATUS

of Fig. 5 to the recorder, which is of the thread type, as supplied by the Cambridge Instrument Company for use in connection with gas analysis measurements.

The record for the last few hours is always visible and the actual percentage of dissolved oxygen at any moment can be read on an engraved scale fixed over the pointer. The chart is ruled for twenty-four hours, the record space being 95 mm. wide. The standard range is 0–1 c.c. of oxygen per litre of water. The complete mechanism is enclosed within a robust dust-tight case which contains a rheostat R, which can be adjusted to maintain the current in the Wheatstone bridge circuit constant, so as to compensate for any variations in the battery voltage, the 2-volt battery required being contained in a compartment at the back of the recorder case.

When it is desired to measure the percentage of dissolved oxygen at more than one point in the feed water pipe line, a katharometer, electrolytic cell and scrubber tower are supplied for each point, but two or three points can be connected to one recorder, which is similar to the single-point instrument, but is fitted with two or alternatively three differently coloured threads mounted upon a frame which is periodically tilted so that each thread is brought in turn under the galvanometer pointer, the connections being automatically changed when the thread is changed, with the result that either two or three distinct records are obtained on one chart. By mounting two galvanometers side by side in one case and fitting double or triple-thread frames, four or six records can be obtained on one chart of double the normal width. When it is desired to read the percentage of dissolved oxygen directly on an indicator scale and a continuous record is not required, a suitable indicating instrument is provided, instead of the recorder. Combined indicating and recording instruments are also supplied.

SIXTY YEARS AGO.

IN our first issue of the year 1867, dated January 4th, we attempted in a lengthy article to take stock of the position reached in the principal branches of engineering, and to forecast what were likely to be the developments of the immediate future. It is evident from the remarks with which the article opened, that there was need in those days of Victorian self-complacency to emphasise the fact that perfection had not yet been reached in any direction, or that it was even within sight. To many it appeared a wonderful age, beyond the achievements of which it seemed difficult or impossible to pass. To-day the same feeling regarding our own age is experienced by many, but just as the chronicle of 1867 reads curiously, so, too, may we assuredly expect, our record for the current year will, sixty years hence, appear delightfully old fashioned. Sixty years ago we found it difficult to foretell what improvements were practicable on our railway systems. Beyond extensions very little appeared open for achievement. There was little room for improvement in the details of the locomotive except, perhaps, some means of burning coal without smoke. We made a reservation regarding Mr. R. F. Fairlie's engines, which seemed to contain a promise of a considerable departure from orthodox practice in the near future. In marine propulsion, too, there appeared little or no room for great improvement, or at least no existing possibility of effecting it. The Waterwitch, representing an attempt to introduce a new form of propulsion and the "cigar ship" representing a new idea in naval architecture, had both given very poor results, and in certain respects were total failures. In the generation of power there was still room for effecting considerable gains of efficiency, but short of a change in the law of the conservation of energy or of some remarkable chemical discovery, we could not hope that any motive power would be invented that could take the place of the steam engine. Increased economy in the production of steam might, we anticipated, result from the discovery of some means whereby only the proper amount of air to give complete combustion was admitted to the furnace, or by the precombustion of the coal in a non-conducting chamber separate from the boiler proper. The use of petroleum in place of coal might, we wrote, be rendered practicable by the proposal to inject the products of combustion directly into the water of the boiler. That proposal—it has within the past year or two been revived—had at that date actually been tried with coal as the fuel, but difficulties were encountered from the accumulation of ashes and soot within the boiler. With petroleum these difficulties, we suggested, might vanish. Among the materials used by the engineer we looked for considerable advance as a result of the development of the new ally found in steel, but we had a caution to utter. The wild dreams of some people regarding immense bridges and other structures in steel would be falsified by the fact that in all probability we would never be able to place a stress on steel greater than 8 tons or little more than half as much again as we could place on wrought iron.

SCHEMES IN SOVIET UNION.

ACCORDING to a message from Moscow, the President of the Gosplan (State Planning Commission), when addressing recently a meeting of the C.T.O. (Council of Labour and Defence), discussed the plans for big constructional undertakings in the Soviet Union during the present year. With the completion this year of the Volkhov and Zages (Zem-Avchalski) Electricity Works, certain funds would, he said, be available for investment in other schemes. After a consideration of many of them the Gosplan had come to the conclusion that the most advantageous for the development of the Union's economic life would be the construction of the Dniepar Electricity Works (Dnieprostroi), the Semirechensk Railway (Central Asia), and the Volga-Don Canal. The construction of the Dnieprostroi was unquestionably advisable. The southern mining region was the chief centre of industrialisation ; moreover, in this region extraordinarily favourable natural factors existed, namely, the proximity to the iron ore and coal mines, which assured the best and most economical organisation of the heavy industries. The building of the Dnieprostroi would also solve the problem of the supply of power for the southern mining region, and, to a certain extent, that of transport, making the whole length of the Dnieper navigable. Agriculture would also reap considerable benefit, as the raising of the level of water in the Dnieper would render possible the irrigation of huge areas in the dry parts of the Ukraine.

As for the second project, that of the Semirechensk Railway, in the first place it would help to solve the raw material problem, as the railway would assure the supply of Siberian grain to the cotton-growing regions of Central Asia, and thus further the development of cotton culture. When it was considered that the textile industry had to spend tens of millions of roubles every year on foreign cotton, the advisability of this railway was indisputable. Timber, animal products, &c., of which there was a superabundance in Siberia and an acute shortage in Central Asia, could also be transported. Preliminary estimates of the cost of the line, which would be about 1500 versts long (about 1000 miles), were from 140,000,000 roubles to 150,000,000 roubles.

The cutting of the Volga-Don Canal would give a great impetus to the development of agriculture along the Volga, as agricultural products would then find a way to the Black Sea and thence to foreign markets. The canal would also serve for the transport of Donetz coal to the north and be of great importance for the export of timber *viâ* the Black Sea. The problem of the Volga-Don Canal was a very complicated one, requiring thorough study and the realisation of many preparatory and subsidiary works, such as the improvement of the Rostov Port and the running of the Azov Canal to this port. During this financial year, concluded the President, it was evident that the realisation of the canal project could not be initiated ; it was therefore necessary to limit efforts to preparatory work which would render possible the actual execution of the project in the not distant future.

ONE advantage of the system of using air pressure, instead of deadweight, for loading hydraulic accumulators, is, according to the *South African Engineer*, that the hydraulic pressure can thereby be quickly reduced or increased to suit the size of the pieces which are being forged, and this effects a considerable economy when forging light pieces, because the hydraulic pressure can be regulated exactly to suit the weight of the work. Another advantage is that it renders the hydraulic press itself much more rapid in action. This is due to the fact that, if the accumulator is weighted, it cannot be arrested quickly, whereas the forging press comes to a sudden stop at the end of its stroke and thereby a big overload is experienced in the pipe, in the valve, and the various joints in the hydraulic circuit. With the air ballast accumulator the kinetic energy in the accumulator moving parts is enormously reduced, and the overload on the piping line is hardly noticeable. Further, the system much reduces the cost of the heavy foundation work which is otherwise required under the accumulator.

Railway Matters.

WE can only see the name of one railwayman in the New Year Honours, and that is Mr. Edward Maltby Bland, the general manager of the Nigerian Railways, who is made a C.M.G.

ON June 1st last the cost of living figure was 68, which was for its purpose accepted as 70. As on December 1st it was 78—accepted as 75—railwaymen are entitled to an additional shilling per week as from January 1st.

THE new administration of the London, Midland and Scottish Railway by four Vice-presidents came into operation on Saturday last, January 1st. Mr. Burgess, the general manager, does not, however, retire until March 31st.

IN order to allow for long non-stop runs in Scotland water troughs are being laid down by the London, Midland and Scottish Company, at Floriston—6 miles north of Carlisle—at Strawfrank Junction—Carstairs—and at New Cumnock.

OF the 9408 locomotives on the Class I. railways of India 91·2 per cent. are equipped with the vacuum brake, as are 90·3 per cent. of the 23,390 coaching vehicles; 3·81 per cent. of the latter are piped for the vacuum brake. It is instructive to note that of the 220,470 goods wagons 57·3 per cent. are equipped with the brake and 14·6 per cent. are piped.

ONE of the difficulties the railway companies have to contend with in their supply of coal wagons is that they are required at the ports to handle imported coal. That is a condition that will last for some weeks to come, as Sir John Hindley, the chairman of the Coal Importing Committee, said in an interview reported in *The Compendium* of last Saturday. "It is very doubtful whether we shall see the last of the foreign imports before the end of February, and for some weeks to come arrivals must be on a pretty big scale, but, of course, week by week on a descending one."

THE steady improvement of the Canadian National Railway is shown by the annual report of the Canadian Department of Railways and Canals. While in 1920 operating results showed a deficit of $34,582,000, operations during succeeding years have shown surpluses increasing from $2,886,000 in 1922 to $32,264,000 in 1925. The total deficits which have been met from year to year by loans from the Government and other sources amount to $356,308,000. The report states that the pronounced improvement of 1925 carries with it the expectation that the management of the Canadian National Railway will be in a position to pay all its interest charges due to the public from its own earnings.

THE Turkish Grand National Assembly recently passed a Bill authorising the issue of industrial bonds amounting to 200,000,000 Turkish liras for the construction of railways, and the development of ports and hydraulic enterprises. These bonds will be issued by the Agricultural Bank, and will be secured on the revenues from the tobacco, matches and spirits monopolies. The Assembly also voted 50,000,000 Turkish liras for the construction of the Heraclea-Angora Railway and 6,000,000 for the construction of a port at Samsun. Among other railway schemes under consideration are lines between Angora, Cesarea, Sivas and Samsun; between Trebizond and Erzerum; between Kutaia and Tavchanli; between Cesarea and Ulukishla; and between Malatia, Angora and Diarbekir.

THIRTEEN passengers were killed in railway accidents last year—one at Bishop's Stortford on May 10th; three on the same afternoon at St. Margaret's, Edinburgh; and nine at Rawmarsh on November 19th. The first two accidents were collisions during the general strike, and the drivers concerned were volunteers; the last was due to a broken drawbar. Whilst during the previous twenty-five years of the present century there were nine years with fewer accidents and fourteen when the number killed was less, the figures in 1926, in both respects, are on the average for the whole of that period. During the twenty-five years in question there were 66 fatal train accidents, or an average of 2·64 per annum, and 602 passengers killed, or an average of 24·08 a year. But the latter included Quintinshill and, were that accident excluded, the average would be 12·72.

GREAT activity in railway construction in Western Canada will prevail this year. The policy of the Government, as outlined at the opening of Parliament, includes a three years' programme of extension of the Canadian National Railway system, the most important item of which will be the long contemplated line to open up the Peace River District of Northern Alberta. The completion of the Hudson Bay Railway is also promised. The opposition which some of these projects encountered in previous sessions may be renewed, but the Government has such a substantial majority that their adoption is practically assured. The Canadian Pacific Railway will also undertake construction of additional lines on a large scale. It is announced that six branch lines aggregating 200 miles will be built in Saskatchewan and Alberta, and lines will be extended northward into the territories lying northwest and east of Lloydminster, in addition to other districts being developed.

A MATTER calling for the attention of those responsible for the maintenance of railway buildings was revealed in a report by one of the assistant inspecting officers. A steeplejack had occasion to repair a chimney and his inspector, when instructing him, saw a crawling board on the roof of the power house concerned, and warned the man to be careful to examine it if he intended to use it. What the man did is not known, but almost as soon as he put his weight on the board it broke and he fell to the ground and was killed. On examination it was found that the timber was perished, and the report on the accident says that the practice of leaving such boards on the roof, exposed to the elements for indefinite periods, between use, is undesirable. Not only is their inspection difficult to carry out in that position, but they are a ready trap for the unwary who may or may not realise the importance of examining them before use, and, in extreme cases, they might even become a danger to others through falling by their own weight.

Notes and Memoranda.

AN analysis of the many official heat tests that have been conducted on concrete and a review of the opinions of the best authorities on this subject disclose, according to the *Engineering News-Record*, the fact that dehydration begins at approximately 500 deg. Fah., and that until that temperature is reached the water of combination is not driven off and no injury results.

THERE are more than 6,000,000 acres of cultivable land lying waste in Bengal at present, and a further 4,000,000 acres are lying fallow. This land remains uncultivated chiefly owing to the fact that the available supply of moisture is insufficient for the purpose of raising crops. Irrigation is required not only for the purpose of improving existing agriculture and bringing waste and fallow lands under cultivation, but also for the purpose of reducing malaria.

THE bort, which is often used as a substitute for the black diamond, is an imperfect gem stone or white diamond. It is fully as hard as the black diamond, but is a single crystal and fractures more readily. Borts may prove a good substitute for black diamonds in oil drilling where the formations are comparatively soft and the danger of breaking the stones is consequently much less than in hard formations. However, operators who have tried borts for coal prospecting have almost invariably found that black diamonds were more economical.

CHIMNEY damage in the Cuban hurricane of October 20th is reported on, in the *Engineering News-Record*, by N. M. Stineman, of the Portland Cement Association, after full study of the hurricane damage as follows:—"Reinforced-concrete chimneys in twenty-seven cases out of twenty-eight were uninjured, while nearly every chimney made of brick or steel was completely wrecked or seriously injured. One concrete chimney broke in half during the storm, but evidence clearly shows that it was of insufficient section, under-reinforced and poorly built."

A TELEVISION projector, which he believes will result in the realisation of the anticipations of radio cinematographers, was recently explained by Dr. Alexanderson, an engineer of the General Electric Company and Radio Corporation of America. He stated that he had accomplished the wireless transmission of a single photograph in two minutes and said that what was now needed was the reception and reproduction of pictures in one-sixteenth of a second. A Transatlantic conversation in which it would be possible both to hear the voice and see the face of the speakers was, he thought, feasible with the means already to hand.

IN commenting on the failure of an old gauge glass fitting on board a steam drifter, the Engineer Surveyor-in-Chief, Board of Trade, says:—"It is usually considered to be good practice to fit cocks at the boiler ends of the pipes connecting the boiler with the water gauge column, and had that been done the escape of water from the boiler could have been controlled. This modification has now been adopted. The fitting was very old and the thread on the gland was probably worn away by long usage. The explosion illustrates the need for great care in overhauling and examining such fittings, especially in boilers in which no alternative means for ascertaining the water level are provided."

INFORMATION was recently received by the Institute of Chemistry that a borough council had demanded the right to inspect a private house in which a member of the Institute had a small chemical laboratory exclusively for his own use, without assistants, and in which no form of manufacture was conducted. An inquiry was, therefore, addressed to the Home Office, as to whether a local authority had any such right and particularly whether a laboratory for professional practice of chemistry was regarded as a factory. In reply, the Deputy Chief Inspector of Factories stated that such a chemical laboratory as that described would not come within the scope of the Factory and Workshop Act.

IN commenting on the explosion of a hot plate the Engineer Surveyor-in-Chief, Board of Trade, says:—"As in this case, it has often been found after explosions from cast iron hot plates of this type that many of the stays cast solid with the body were broken. Frequently the fractures were obviously of long standing, and it is not improbable that they had resulted from uneven cooling when the plates were cast. The stays, being inaccessible for inspection, should be reliable, and with this in view screwed stays should be used where possible; if, however, for practical reasons the stays are required to be cast solid with the body, care should be exercised in designing and casting them of better forms for resisting strains due to variations of temperature than are often found."

ALTERNATING-STRESS fatigue tests of cast steel, carried out at the University of Illinois by Professor H. F. Moore, are reported in Bulletin 156 of the Illinois Engineering Experiment Station. The specimens tested were cast so as to avoid the liability of internal defects, and were distinctly better than ordinary castings. They ranged in tensile strength from 67,000 lb. to 109,000 lb., according to the heat treatment applied. The ratio of endurance limit to ultimate strength was almost constant, ranging from 0·40 to 0·46. No similar correlation with elastic limit, yield point, Brinell hardness or Charpy impact resistance was found. One of the types was normal cast steel, while the other was high in manganese, containing 1·71 per cent. against 0·68 per cent. for the normal steel.

ENORMOUS losses occur annually in the petroleum industry in the United States owing to the formation of water-in-oil emulsions. In a recent two-year period it is estimated by the Bureau of Mines, Department of Commerce, that 100,000,000 barrels of this "cut oil" were produced in the Mid-Continent and Gulf Coast fields and only half was successfully treated. During these two years 568,039,000 barrels of crude oil were produced in these two fields. Almost one-fifth of the oil from these fields, therefore, required treatment before it could be marketed. During this period the average price for oil in the Mid-Continent and Gulf Coast fields was about 2 dollars per barrel, making a total of some 200,000,000 dollars involved. In California over 15,000,000 barrels of clean oil were recovered in one year from cut oil by electrical dehydration alone.

Miscellanea.

EXTENSIONS are being made to the Harbin Electric tramways, at a cost of about £130,000.

AN electricity supply for Kulangsu, in the Fukien Province of China, at a cost of some £25,000.

THE Fourth Conference on Extra High-tension Systems will be held in Paris from June 23rd to July 2nd, 1927.

THE Irish engineering and foundry firm of Harrison, Lee and Sons has completed ninety-six years' continuous activity.

THE bituminous sands of Northern Alberta are to be used by a Californian company for road surfacing in Western Canada.

IT is announced that the Carolina Light and Power Company is installing five electric storage batteries, each of which weighs 100,000 lb.

IT is proposed to expend $12,000,000 on the further development of the port of Montreal. The scheme includes the extension of the grain elevators.

THE revenue of the telegraph offices along the Chinese Eastern Railway, in Manchuria, has shown a sharp falling off during recent years owing to the growing competition of the long-distance telephone services.

AN extensive programme of development in the manufacture of iron and steel in Western Canada has been embarked upon by the Maple Leaf Steel Mills, Ltd., which has a capital of $500,000 and works at Edmonton.

IT is claimed that with the recently proposed additions to its plant the Staveley Coal and Iron Company will have one of the largest stations generating electricity from coke oven gas. The ultimate capacity of the plant is some 28,000 horse-power.

OPTIONS have been secured on waterfront property on Burrard Inlet, Vancouver, for the construction of a large cold storage warehouse, which, it is believed, will go far towards solving the problem of the disposal of the British Columbia fruit crop.

THE preliminary work for the construction of the great barrage to be erected on the Moldau, near Stechovice, about 20 miles south of Prague, is now so far advanced that it will be possible to start on the embankment itself this year. The work is expected to take five years to carry out.

WORK has now been proceeding on the great hydro-electric scheme on the Susquehanna River, Maryland, which will have an ultimate capacity of 594,000 horse-power, for nearly a year. A force of 3000 men is employed on the works, and it is hoped to get the first unit in commission about the middle of 1928.

AN exhibition of some of the results of research recently carried out on adhesives application has been arranged at the Science Museum, South Kensington, by the Adhesives Research Committee, which has been set up by the Department of Scientific and Industrial Research. The exhibition will remain open for some months.

THE Herne Bay Waterworks are putting down a 7in. four-stage, vertical, centrifugal bore-hole pump, by Worthington-Simpson, capable of delivering 650,000 gallons of water a day, against a total head of 310ft. It will be driven through helical bevel gearing by an 80 brake horse-power two-cylinder Marshall oil engine, running at 300 revolutions per minute.

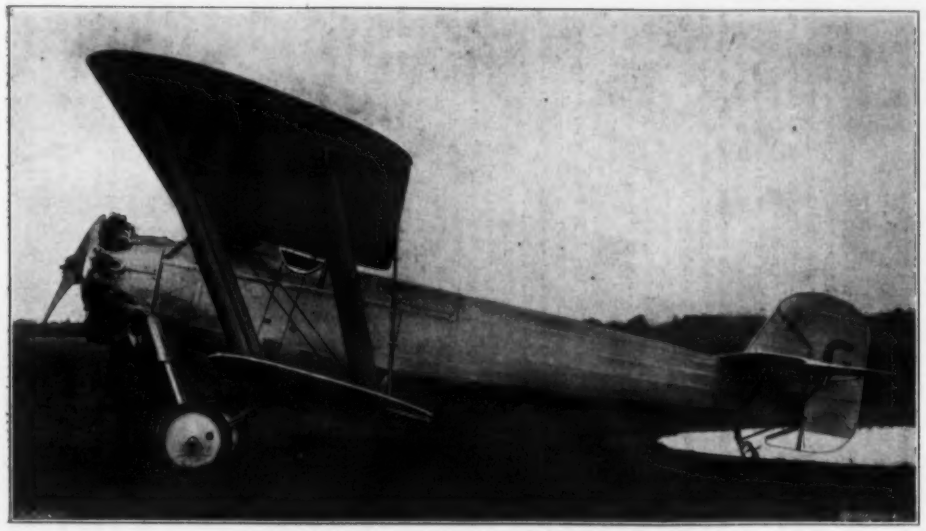
THE second technical paper of the Forest Products Research Laboratory of the Department of Scientific and Industrial Research, which has just been published by H.M. Stationery Office, price 1s. 3d., deals, like the first, with the movement of moisture through wood. The importance of experiments on this subject will be understood when it is realised that success in the kiln seasoning of wood can only be attained with a thorough knowledge of this process. The experimental results obtained should assist the kiln engineer, since they emphasise those features which must be taken into consideration in kiln design if artificial seasoning is to be an efficient and economic practice.

AN interesting review of trade and economic conditions in the Union of South Africa was given, according to the *Iron and Coal Trades' Review*, at a recent meeting of the South African Section of the London Chamber of Commerce by Mr. J. McBride, who returned not long ago from a lengthy visit to the Union. He referred briefly to the Natal section of the South African coal industry. It was a lamentable fact, he said, that for many years past this valuable asset had been seriously crippled by failure to provide an adequate and continuous supply of railway rolling stock to deal with the business on hand, and he could say quite frankly that no coal mine in Natal dared sell forward its total output owing to the fact that it could not rely on the railways regularly supplying the necessary trucks. When he was out there the average daily truck supply to the mines was only about 60 per cent. of their actual requirements. Apart from the serious financial loss this meant to the mining companies, the railways were losing revenue to the extent of over £600,000 per annum.

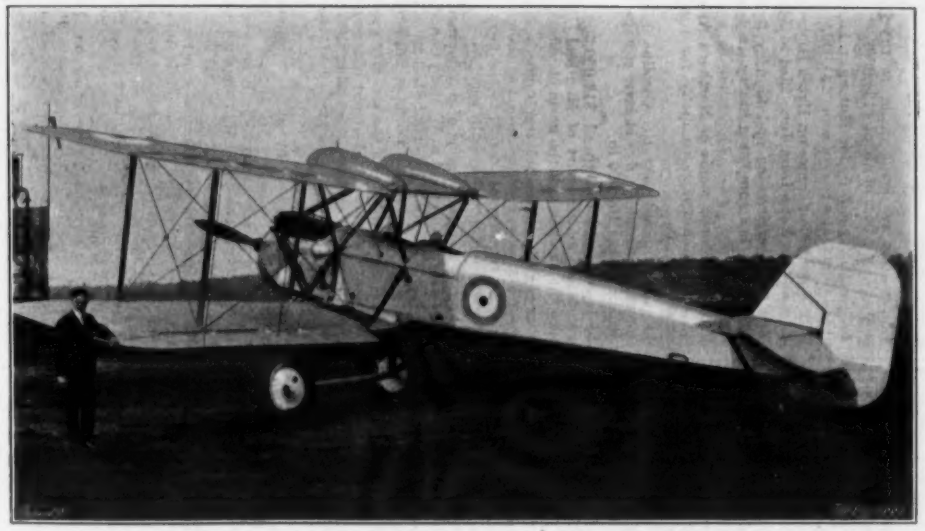
THE Hoover Commission, which was appointed by President Coolidge to advise upon the development of a canal from the Great Lakes to the Atlantic, has reported in favour of the St. Lawrence route against the two rival projects for an all-American canal to the Hudson and the Lake Ontario-Hudson-Welland Canal route. The construction of a canal of sufficient depth to admit ocean shipping from the Atlantic to the Great Lakes is declared by the Commission to be an economic necessity for the Middle West, and the St. Lawrence route, as recommended by the Canadian and American Joint Board of Engineers, is, according to Mr. Hoover and his colleagues, undoubtedly the best from every point of view. The Commission bases its preference for this route on the advantages in cost and maintenance, and especially on the belief that the scheme would make possible the largest hydro-electric development project in North America, providing for a total of 5,000,000 horse-power, of which about one-half lies in the upper rapids along the international sections between the State of New York and Ontario.

SOME AEROPLANES OF 1926

(*For description see page* 19)

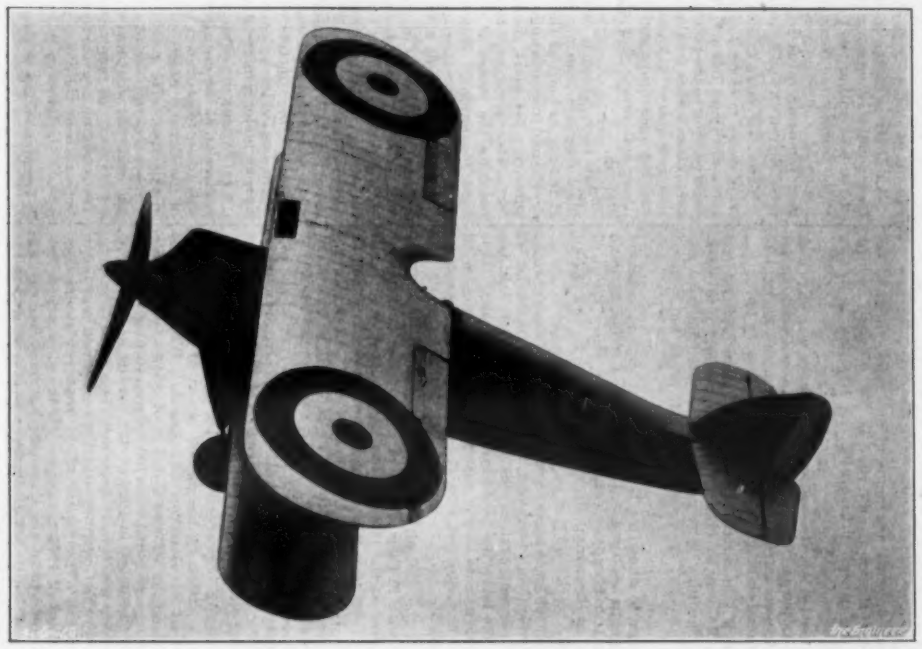


VICKERS "VESPA" ARMY CO-OPERATION TWO-SEATER



VICKERS "VENDACE" TWO-SEATER TRAINING MACHINE

HANDLEY PAGE "HENDON" SLOTTED-WING TORPEDO CARRIER



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THE ENGINEER.

JANUARY 7, 1927.

A Retrospect of 1926.

NEVER in its seventy years of existence has THE ENGINEER been compelled to put on record such a history of colossal folly as that of 1926. The great Coal Dispute, which opened with the futile General Strike on May 3rd, dominated the year. What it cost the country no one can say with certainty, but the figure of four hundred million pounds which has been estimated in some quarters, great as it appears, may be accepted as a not excessive figure for the immediate pecuniary loss alone. What the collateral losses may be cannot even be guessed. Contracts had to be broken, orders were lost, markets were left open to competitors, and developments were delayed. It will take as long to recover completely from that seven months' struggle as from the four years of the Great War.

And all for what? For nothing at all. At the end of the dispute we were back at its beginning. The miners, under the leadership of Mr. Cook, had fought an economic fact, and were beaten by it. That fact was patent to all from the first. Mr. Cook himself cannot have failed to see it, and there is little or no doubt that his motives were political rather than industrial. His object was so to involve the State with the mining industry that no other course remained but the nationalisation of the mines. With great skill he kept the Government imbroiled in the dispute from the spring to the autumn, and, perchance, nearly succeeded in his object. It was with the coalowners' refusal to take part in any more abortive conferences at the Government's call, for which they were reprimanded by the Prime Minister and reproached by the Press, that the beginning of the end came in sight. Soon thereafter the Cabinet washed its hands of the affair, and then, despite the frantic efforts of Mr. Cook to continue the useless struggle, men began to return rapidly to the pits, and on November 29th, or thereabouts, Peace was officially restored.

We cannot believe that any other country in the world would have tolerated the complete arrest of its greatest basal industry as this country did. The whole population stood aside whilst the struggle proceeded. It complained about the delay of trains, the lack of coal, the loss of work, the increase of rates and taxes, but it never made a voluble protest against the continuance of the dispute. Here and there a few papers had the courage to expose the motives behind the dispute, but the country took little more than a good-natured smiling notice of them. It said of miners and owners, *Arcades ambo*, and left it at that. Unable to judge between the rights and wrongs, ignorant of the economic facts, saturated with the principle of free speech and fair play, it deliberately stood to one side whilst every industry in the country was paralysed. Surely the gods must have laughed at its stupendous folly! Had a hoarse disciple of the Red Flag overstepped the bounds in Hyde Park, had a woman broken a plate glass window to further woman-suffrage, had an editor or an author published a few defamatory words of the Army or the Navy, the law could have been put in motion. But if a Communist cares to call out a million men, to stop the supply of coal, and to involve the country in a loss of many hundred millions of pounds, the law is powerless. It is an industrial dispute and he may do what he will; it is a political dispute and impartiality must be shown; it is a communistic movement, and a revolution is to be feared; he is the idol of a million, and must not be martyred. By such excuses did the country support its folly and permit the dispute to continue, whilst it aimlessly waved its feeble hands and implored the Government to do something. Every borough, city, town, village and hamlet should have held its meetings of protest against the dispute, a petition of ten million names should have been conveyed in a fleet of motor lorries to the House of Commons; the innermost recesses of the law should have been searched for precedents for the suppression of speeches which were injurious to the country. Instead of lounging good-humouredly through the seven months, the country itself should have taken up arms against those who continued it; instead of crying, "Why does not the Government do something?" it should have seen that the Government did do the only sensible thing that could be done—put an end to picketing, prohibit speeches, and stop the inflow of foreign gold for the communising of Great Britain.

Now that it is all over, What?. Will anyone move the indictment of Mr. Cook for treason; will anyone move for an inquiry into the conduct of the whole affair by both sides; will anyone trace the objects of the trades union leader, and tell us whether or no they were fairly such that the work of the nation might be suspended for them? Assuredly not. Nothing will be done. Did anyone sell the plans of a submarine to a foreign Power, he would be tried and punished; but he may do the country far, far more harm and not a single voice will be raised to demand that the legality of his actions shall be examined. To such an absurd extreme do our principles of toleration lead us. We shall go on as we have gone. If next year Russian revolutionaries can stir up some other vast industry to revolt, and if the Government is misguided enough to give it the appearance of a political measure, we shall have the same thing repeated. Toleration carried too far becomes weakness, and we say deliberately that the time has arrived when means must be provided for examining the fundamental purposes of all who would encourage industrial disputes and for bringing them within the law if that purpose is found to be one designed with intention to injure the industries of the land.

The coal dispute—a "strike" in truth, for the mines were always open to those who wished to return to work—produced one immediate good result, and will lead, it may profoundly be hoped, to another. On July 8th, the Eight Hours in Mines Act received the Royal Assent. That permissive measure, which enables mine managers to restore eight-hour shifts where they are an economic necessity, will go far to put the mines once again upon a sound basis. Combined with the fact that the best men were the first to return, the output of coal per worker has been higher since the end of the struggle than when it began. The second good result resides in the attention that was directed to the methods of peaceful picketing. Of those methods we need not speak. If Examination in the Third Degree can be called peaceful, then the moral picketing of wives and children may also be called peaceful. That was not the intention of the Trades Disputes Act. It is understood that at an early date the Government will bring in a Bill to put an end to that offence. At one time it was believed that the Bill would also make the secret ballot in trades unions compulsory, but rumours were current at the end of the year that, owing to the difficulties of organisation, that subject would be dropped. Holding as we do from knowledge of workmen that many of them are not in sympathy with the militant actions taken by their unions and that they would oppose them did they not fear victimisation, we sincerely trust that these rumours may be untrue. At any rate, it would be well to include the necessary clauses in the Bill in

order that they might be examined through and through. It is probable that in any case restriction will be placed upon the wholesale use of trades union funds for political purposes, and that in itself will do something to stop the abuse; but at the same time the opposition of the trades unions to the secret ballot is sufficient evidence of their belief in its value to them. They know that the open ballot would be more truly representative, and for that reason fight against it.

High Pressures.

It is pleasant to turn from this record of folly and weakness to matters which are outside the influence of political intrigue. Whilst the instability of Labour has undoubtedly an effect upon the general advance of engineering, and particularly mechanical and electrical engineering, the general tide of improvement moves along, and, as year succeeds year, there is always some technical progress to put on record. The principal facts of 1926 are covered by the special articles which occupy the greater part of to-day's issue of THE ENGINEER, and it is unnecessary to refer to them specifically, but there are one or two matters upon which it is desirable to lay a little stress.

In steam engineering the continued progress of high pressures deserves particular attention. We described during the year the Langerbrugge power station, in which a steam pressure of 800 lb. is regularly employed—see THE ENGINEER, June 4th—and in our issue of December 31st a boiler designed and constructed by Sulzer Brothers for a pressure of 1500 lb. was dealt with. Against these foreign developments we may place the turbine steamer King George, built by Dennys, and fitted with Parsons turbines and Yarrow boilers for a working pressure of 550 lb. Such things as these are indicative of the future. Whether 350 lb. and a total temperature of 750 deg. Fah. is, as some hold, the limit to which it will be economical and practical to go for some time to come, we cannot say, but it seems to be improbable. The utilisable temperature is, at the moment, controlled by the quality of material which the metallurgist can provide for steam fittings, and we have little doubt that as experience is gained and is pursued by the help of research metals suitable for much higher temperatures will be found. It is not likely that pressures as great as 1500 lb. will be common for many years to come, but even now 350 lb. may be regarded as the standard pressure for land and marine stations, and occasional examples of 500 lb. and over occur. A very remarkable contribution to the whole subject was presented by Mr. H. L. Guy in a paper which he read before the North-Western Branch of the Institution of Mechanical Engineers on November 4th. It was reprinted in full in our issues of November 12th and 19th. Mr. Guy appears to have reached the conclusion that whilst the present prices and conditions obtain it is not really economical to carry the pressure for power stations above 640 lb.; but as he made clear in a letter published in THE ENGINEER on December 10th, he sees no reason why pressures should not with advantage be carried much further if conditions alter. Mr. Guy's views are interesting, because they bring out the oft-forgotten difference between efficiency and economy. It is the business of the engineer to show how efficiency can be improved, but it is his business, too, to show that the efficiency may cost more to secure than it saves. The next step is, then, to modify the conditions so that the higher efficiency comes within the bounds of economy. That, we take it, is the line of progress that must be followed in the use of ever higher steam pressures and temperatures.

Metallurgy.

Industrial metallurgy has nothing of outstanding merit to be recorded in its honour in 1926. A great deal of research was carried on, both at home and abroad, as those who read our monthly Supplement, THE METALLURGIST must know, but whilst some of the matters studied hold out prospects of future industrial usefulness, and others, being pure research, may contain the practical inventions of the future, it cannot be said that either at home or abroad any new advances of great interest to engineers were secured, though we must not forget that the use of "normalised" steel for shipbuilding established itself by the success of the Prometheus. It is desirable to recall also in this connection that the part which metals play in aeroplane construction is now much greater than heretofore, and that 1926 saw great progress in that direction. All-metal aeroplanes and flying boats are now being made in this country, on the Continent, and in America, and in the last-named country an all-metal airship is under construction. In all probability wood and fabric will soon be things of the past for aircraft. For this remarkable development not a little of the honour is due to metallurgists who have given us metals of suprising strength and lightness. Unfortunately, the problem of corrosion remains and its significance in aircraft construction can be appreciated when we recall that the total cross-section of all the girders used as longitudinal members in the R 33 is only eight square inches. In that case, duralumin was used, but in others steel is being employed, and the serious effect of corrosion on such thin material is obvious. We may add that the employment of protective varnishes is prohibited on the grounds of excessive weight!

Electricity Supply.

An event of the year which, in the opinion of its promoters, will have vast industrial effects was the passage of the Electricity Supply Bill which became an Act of Parliament on December 15th. By providing for a vast network of supply mains—the "grid"—throughout the country, it is hoped that even agriculturists will be encouraged to use electricity, and that the general demand for it will increase enormously. It is too soon to say whether or not these hopes will be fulfilled, and whether it will be possible to supply current at an attractive rate. It appears to be not improbable that the capital cost and upkeep cost of the grid and its accessories will be so high that a low price per unit will be impossible. But it is not definitely known what effect price has upon consumption, for it must not be forgotten that in America, for example, where the price of a unit is in many places far higher than in this country, the consumption per head is much greater. A grave objection to the Act is that, by placing the organisation in the hands of a body of men appointed by the Ministry of Transport, it approaches perilously near to nationalisation.

London Traffic.

In our last annual review we touched upon the Waterloo Bridge question, and firmly expressed our opinion that it was unnecessary to destroy Rennie's famous structure, and that it would be folly to place a much wider bridge in that position. For several months of the year the problem continued to agitate engineers and general relief was felt when a Royal Commission was appointed to inquire into the whole question of cross-river traffic in London. With regard to Waterloo Bridge, that Commission took the same views as those we had expressed. It foresaw the congestion that would ensue if a very large bridge at Waterloo were allowed to discharge into the already overburdened Strand, and after a very careful examination of engineers, it reported that the present bridge could be restored and without much trouble be widened to take four lines of traffic. We may sincerely hope that its recommendations in this respect will be accepted, and that the necessary work will be put in hand at once. Of the rest of the scheme for improving cross-river traffic, it is unnecessary to say much at this time, for it is unlikely that the huge works recommended, as, for example, the magnificent scheme for the improvement of Charing Cross and the construction of a new bridge—Ludgate—beside Blackfriars Bridge, will be undertaken in the present year, though some of the lesser works are already pressing and may be begun at an early date.

Locomotives.

What effect, if any, the Electricity Supply Act may have upon British railways there is as yet no evidence at all that the electric locomotive will replace the steam locomotive at an early date. Yet the prospect of that eventuality may be having its effect, for the efficiency of the steam locomotive is being studied with greater and greater care as years go by. Not only do we find new types like those driven by turbines and oil engines being introduced, but we see locomotive engineers exploring the possibilities of compounding, of higher pressures, of new cylinder arrangements, of new valve gears, and of such auxiliaries as air preheaters and feed-water heaters. All this indicates that the steam engine is not prepared to be superseded without a struggle, and the advantages of certain changes are so marked that it may safely be said that the competition of the electric and of the internal combustion engine is made more difficult. The straight steam locomotive has merits which it is impossible to deny. It is a simple machine by contrast with any of its rivals, it is cheaper in first cost, and its maintenance is relatively low. Against these advantages has to be set the undeniable fact that its efficiency is small. The turbine locomotive can offer a higher efficiency, but it yet remains to be proved that, taken over years of service, it is in the long run better than the old type. On such a point nothing but experience can give a definite answer, and we view with the greatest satisfaction the appearance of two turbine locomotives in this country. It is sincerely to be hoped that both may be run in ordinary "links" for a year or two, so that their economy, which is of even greater moment than their thermal efficiency, may be thoroughly studied. There is probably no machine, not even the marine engine, which demands long periods of service tests so much as the locomotive does. The turbine locomotive may succeed in establishing itself in Great Britain, or if it fails to do so in this country, it may do so in others where fuel is more expensive and good water is scarce. We do not know. Nobody knows. Nothing less than prolonged service tests can give the right answer.

In one respect the turbine locomotive seems to have solved a problem which has long baffled engineers. We are assured that in both the types now before British railway men the condensers are perfectly satisfactory. That is a very important matter, because even if the turbine itself with its gearing should fail to prove economical for railway work in Great Britain, the long-established reciprocating engine may be greatly improved by the addition of a condenser, and its suitability for countries where water is scarce or bad may be greatly enhanced. Moreover, the bugbear of the locomotive has always been back pressure. Anyone can get steam into a cylinder; the difficulty lies in getting it out fast enough, and in that respect the condenser would give not a little help. In another respect the turbine locomotive may guide the reciprocating engine. The success of Mr. Maunsell's four-cylinder engine, with eight blasts at equal intervals, has demonstrated the improvement in boiler efficiency which is secured by steadying the draught. In the turbine locomotive the draught is produced by a fan controllable by the driver. It would be an experiment of the greatest interest to fit an ordinary locomotive with such a fan; if, in addition, the steam could be condensed, an improvement in efficiency, both of boiler and engine, should result. We suggest the experiment as worth the consideration of the North British Locomotive Company and Beyer, Peacock and Co., Ltd., which are both satisfied with the types of condensers fitted to their respective turbine locomotives.

The internal combustion passenger locomotive has not yet appeared upon British railways, but in Canada it is making remarkable progress, and it is reported that the Canadian National Railroad has decided to order nothing but oil engine locomotives for some time to come, whilst the Canadian Pacific is beginning to take interest in the question. Whilst the competition of types is extremely keen, we rejoice that the engine developed by William Beardmore and Co., Ltd., keeps to the fore, and has during the year proved itself by steady service. The company has in hand for the Canadian National Railways two 1500 horse-power engines which are to be placed on one locomotive. Exhaust boilers are to be fitted for train heaters. We understand that an engine of the kind of moderate power will before long be tested on a British railway, which for many years has shown great readiness to test all means of improving the efficiency of haulage.

If the internal combustion locomotive can be brought to perfection, it has an assured future, and will certainly render the electrification of British railways more than ever remote. It should offer a higher efficiency than the electric locomotive, and at the same time preserve that independence which distinguishes all locomotives which generate their own power from those which do no more than convert that which is supplied to them from a distant power house. The importance of this quality may be minimised by the advocates of main line electrification, but it is only necessary to consider what the position of our railways would be in a general strike were they dependent on power house supply, or to visualise the effect of a successful air raid on a few power houses in the event of war, to understand what a serious question it really is.

Conclusion.

The general strike and the coal dispute had a terrible effect upon the engineering industries

during the year. For just seven months hardly any coal was raised and the foreign fuel that was imported was unsuitable for coking. Hence, blast-furnace after blast-furnace was compelled to close down, until no more than five remained in blast. With the absence of pig iron steel works had to cease work, and the supply of British materials to engineering works came to an end. Foreign steel and iron and coal were bought and so many works carried on with their help that the export trade was maintained at a good level, but on the whole the injury done was enormous.

We are happy to be able to record that the year ended in a much better atmosphere. With supplies of coking coal restored, blast-furnaces were re-lighted, and at the end of December well over sixty were already in blast. Moreover, a large crop of shipbuilding orders was placed, and altogether 1927 opens in a fairly hopeful spirit. In this connection, the Imperial Conference must not be forgotten. Even those who had their misgivings are obliged to admit that the spirit of the Conference was extremely friendly, and that it appeared to foreshadow a strengthening of the bonds between the parts of the Empire. It is felt, too, that Labour is likely to be less ready to make trouble in the immediate future than in the past. It is still regretting the gross folly of the general strike, it has spent fruitlessly a vast sum of money, and it has known unemployment already too long. Moreover, some glimmerings of economic facts are beginning to filter through, and if the politicians who make puppets of the sober workmen can but be restrained, we may hope that labour will give itself the opportunity to discover that employers are ready enough to pay high wages for high service, and that British engineering can hold its place against world competition if it be but true to its great traditions. What is needed is a sturdier independence of individual workmen, and we may add a sturdier independence of employers, who, as we have recently pointed out with regret, show a deplorable aptitude to accept foreign inventions instead of developing their own.

Aeronautics in 1926.

No. I.

A GENERAL survey of the aeronautical developments of the past year reveals a very considerable tendency toward progress in new technical directions. It is customary to speak of the vast developments in aeronautics achieved during the war period. The progress made, it is true, was very great, but it was a progress in performance—in speed, climb, size and duration—rather than in fundamental principle. The machines at the end of the war period were very little more than improved copies of those at the beginning. Had the war not intervened the progress registered in performance would have been delayed, but it is more than probable that increased progress would have been made in the development of principle.

The influence of the war on aeronautical developments persisted strongly for some years after its fever had passed. It is, in fact, only within the past two or three years that aeronautical designers and manufacturers have shown any general signs of being willing to consider and try ideas and methods other than those inherited from those intense days, when production and performance were everything.

The new spirit in aeronautics was manifested last year in several interesting directions. Full-scale trials of an extended and successful order were made of two promising departures from orthodox aeroplane design, namely, the Cierva "auto-gyro" and the Hill tailless aeroplane. The auto-gyro is distinguished by the fact that in it the conventional aeroplane wings are replaced by a large windmill screw rotating freely about a nearly vertical axis under the forward motion communicated to the machine as a whole by an ordinary aeroplane propeller fixed and driven in the ordinary way. The important advantages of the machine are its almost vertical descent and ascent and its low landing speed. Experiments, accorded a high order of priority, were begun at the National Physical Laboratory on a 10ft. model of the auto-gyro lifting screw, and several full-sized machines were built for trial to the Air Ministry's order. Captain Hill's machine, of which more is said hereafter, is distinguished by the sweeping back of the wings to an extent which renders the existence of a separate system of tail planes unnecessary. The machine on trial was found to possess remarkable stability and control, both in normal flight and after stalling, and to have a good performance. The experimental machine constructed by Captain Hill was of a light type, and was described in our issue of April 30th. It is probable that in a short time we will have news of a tailless machine in the form of a biplane.

An even wider departure from conventional aeroplane design than either the auto-gyro or the tailless machine was studied on an experimental basis during the year. The application by Flettner of the "Magnus" effect to the propulsion of ships, immediately suggested the use of rotors in place of wings on aeroplanes. Active experiments were begun in this country and abroad and are being continued. For the moment, it cannot be said that the rotor aeroplane is a practical proposition. Very high lift coefficients are obtainable from the rotor wings, but as far as the investigation has gone at present, it would seem that they are accompanied by proportionately high drag coefficients. It is possible, however, that on the full-size scale the ratio of the coefficients will be more favourable than that found from the models which alone have so far been tested. Given a favourable result in this respect, the problem will still have to be faced of rotating a cylinder large enough to replace the wings of an aeroplane. That the subject is being studied is, however, sufficient evidence of the new outlook acquired in aeronautics during the past few years.

In the airship world the breath of a new spirit was also felt during the year. It was to be found in many of the details regarding the design of the big British airships R 100 and R 101, which were revealed from time to time, but was chiefly noticeable in the information disclosed by the Zeppelin Company concerning its intentions in connection with the propulsion of the 3,700,000 cubic foot airship which the company is now constructing for an experimental Transatlantic service. In this ship petrol or other liquid fuel will be entirely dispensed with. The engines will be run with, as fuel, a gas of substantially the same density as air, and having a calorific value per pound almost the same as that of petrol. The gaseous fuel will be carried at atmospheric pressure in those of the gas bags which otherwise would require to be filled with hydrogen to the extent necessary to lift the equivalent weight of liquid fuel. We examined the proposal and discussed its advantages in our issue of July 30th, to which the reader may refer for further particulars. It may be remarked that in British airship circles the proposal has been carefully examined, and that some doubt seems to be felt regarding its virtues. The nature of the new fuel gas has not been disclosed as yet. Meanwhile, for the new British airships experiments are being conducted with the object of devising a satisfactory means of utilising the surplus hydrogen as an addition to the liquid fuel for the engines.

Another highly interesting airship development consists of the employment of sheet metal—duralumin—in place of the fabric covering commonly used and also in place of the gold-beater's skin gas bags. An all-metal airship of this type involving many radical departures from orthodox design is now under construction by the Aircraft Development Corporation, of Detroit.

In the field of aeronautical engines the desire to depart from orthodox design was also to be traced. It was observable in the efforts made to develop an engine in which single sleeve valves would replace the customary poppet valves, a change which, experiment showed, would diminish the tendency to detonation, permit the use of an increased compression ratio and give an important increase in the efficiency without materially adding to the weight. An even more striking line of departure was the active attention given to the development of the compound-expansion internal-combustion engine. Practical difficulties previously encountered in this direction are understood to have been considerably reduced, and an experimental unit constructed in accordance with Mr. H. R. Ricardo's designs is, we gather, now being built or tested. The aeronautical engine using heavy fuel oil instead of petrol continued to be developed during the year, but official secrecy prevents our learning or disclosing anything concerning the progress registered.

Following our usual custom we now proceed to review some of the principal work undertaken by British aeronautical firms during the year.

Some Typical British Aeroplanes.

As in previous years, our account of the machines produced in the past twelve months must necessarily be regarded as incomplete, in so far as we are prevented from learning or disclosing particulars—in some cases even the names—of recent military and naval machines built for the British Government. The machines concerning which we are enabled to give details will, however, serve in good measure to indicate the general lines of the progress made.

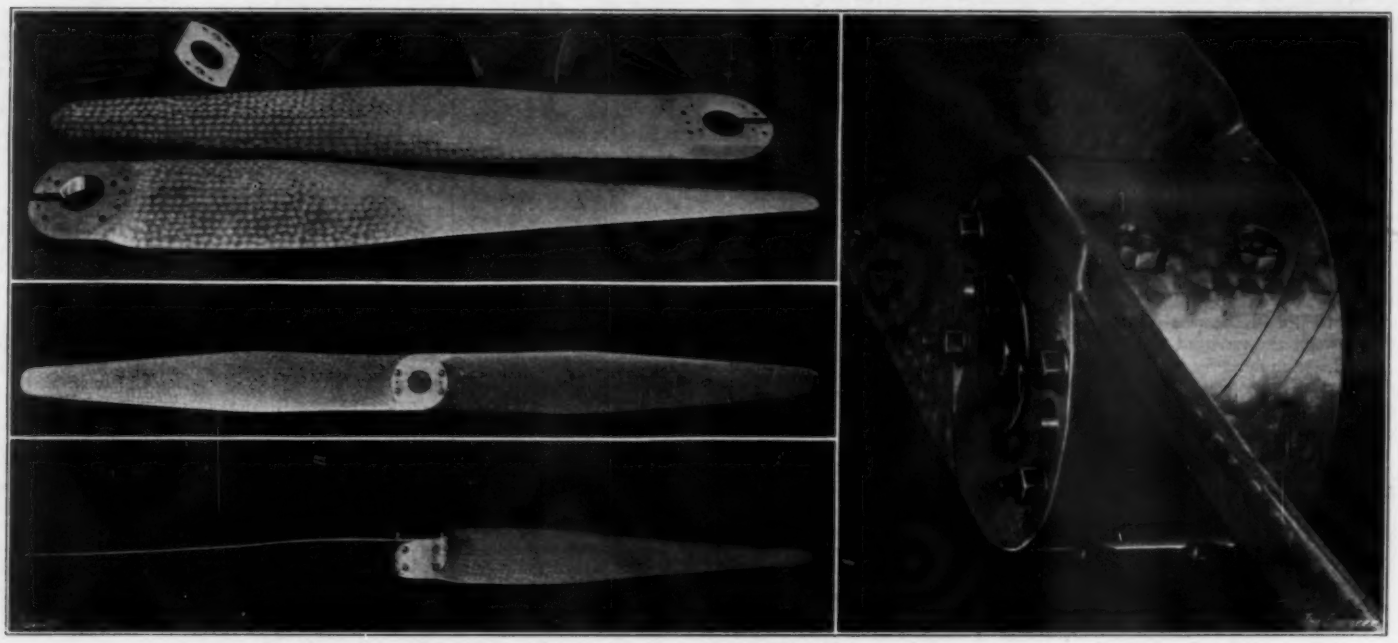
Handley Page, Ltd.—Although the Handley Page "Hendon" two-seater military machine, an illustration of which is given on page 16, was designed and constructed some time ago, we may class it as a machine of the year because it was only last summer that it became permissible to say anything about it. This machine is an experimental one built for the Air Ministry, and is designed to carry torpedoes. Its distinguishing feature is the fact that it is fitted with Handley Page slotted wings. The slotted wing principle, as is well known, reduces the landing speed by anything up to 30 per cent., and very considerably shortens the taking-off and landing runs. The machine, we may therefore suppose, should be particularly suited to operation from an aircraft carrier. In our engraving the slots along the leading edge are shown open. They may be opened or closed by the pilot during flight. In addition, the machine is equipped with slotted hinged flaps in the rear of the wings. These flaps when they are depressed cause the rear slots to open and when they are raised the slots close. The rear slots are not otherwise under the pilot's control. Their presence results in full control being maintained over the machine when its speed falls to or below the stalling speed. The "Hendon" has a total weight of 6970 lb., of which 1956 lb. is useful military load. At sea level it has a speed of 110 miles an hour, which, for landing purposes, may, by the opening of the leading edge slots, be reduced to 45 miles an hour. It can climb at sea level at a rate of 520ft. per minute, and takes 7 min. to reach a height of 3000ft. At cruising speed it has a range of 3 hours. Its "ceiling" is 10,000ft. These figures indicate, as is actually the case, that the slotted wing principle is not without effect on the rate of climb and on the "ceiling" which a machine can reach. The machine is driven by a 450 horse-power Napier "Lion" engine. The Handley Page "Hamlet" machine—illustrated in a Supplement—is a three-engined slotted wing monoplane, designed to carry four passengers and the pilot. Our engraving shows it with the leading edge slots closed; that is, as set for flight after the desired altitude has been reached. It is intended for civil use, and has been built to the order of the British Air Ministry. It is distinctive by reason of the fact that it is the first civil machine with slotted wings built for the Air Ministry, and also because it is the first to be driven by three engines of low power. The engines are three air-cooled Bristol "Lucifers" of 100–120 horse-power each. The use of three engines instead of one is dictated solely by considerations of reliability; flight can be maintained with any two of the engines running. The wings are of the thick high-lift section, and are braced on each side of the fuselage by two steel tubes extending from the front and rear spars to a common point on the lower longeron. The two wing engines are mounted on this tabular bracing. The machine is shown fitted with a land carriage, but it can also be provided with floats for use as a seaplane. In the land form it has a total weight of 5000 lb., of which 800 lb. represents the commercial load. Its maximum speed is 118 miles an hour, and its landing speed 45. With two engines running, its speed is 92 miles an hour. It can take off in a distance of 120 yards and land after a run of 150 yards. The petrol is carried in two tanks outside the body, and under the wings. Sufficient capacity is provided for a flight of about 3½ hours. The performance of this machine will no doubt be the subject of interested study, for it is still not universally accepted that the use of three engines in a commercial machine is, all things considered, preferable to the employment of one.

Supermarine Aviation Works, Ltd.—The "Southampton" flying boat made by the Supermarine Aviation Works, Ltd., Southampton, and illustrated in a Supplement, is another example of a machine which does not strictly belong to the past year, but which, for reasons of official secrecy, could not be dealt with, as it should have been, twelve months ago. The design may well be considered as of historic interest. It was begun in August, 1924, at a time when practical experience seemed almost to be on the point of inducing the Air Ministry to abandon the further use and development of flying boats in general. The first Southampton machine was completed and flying by the middle of March, 1925. Its trials proved in every way satisfactory. In September, 1925, a flight of "Southamptons" was sent on a 10,000-mile cruise round the British Isles in distinctly bad weather. The cruise was carried out to the pre-arranged time-table, without incident. During July, 1926, two "Southamptons" gave a similar good account of themselves on a 7000-mile cruise to Egypt and back. The design by this time had not only proved its merits, but had rehabilitated the flying boat as a type in the eyes of the Air Ministry. The cruises definitely showed that it was quite possible to construct machines which, as a matter of routine, could fly at will over 100 miles an hour, and also ride at anchor on the sea in the face of rough weather. The Southampton twin-engine coastal reconnaissance flying boat—to give it its full title—is now being supplied in large numbers for duty with the Naval Co-operation Squadrons of the Royal Air Force. The machine is driven by two Napier "Lion" engines, of 470 horse-power each. A feature of the design is the monopolane tail with three cantilever fins standing above it. This arrangement gives an unrestricted field of fire to the guns, and has resulted in the abandonment of the belief that flying boats in general are incapable of defending themselves efficiently. The petrol is carried in two tanks beneath the top planes, in which position a gravity feed is rendered possible, and the risk of fire is reduced to a minimum. No petrol is carried in the hull. In the bow of the hull there is a cockpit for the gunner and bomb operator. Behind him sit the two pilots in tandem. Complete dual control is provided, and the after pilot has access to a navigating compartment. Behind this compartment is the wireless telegraphy compartment, which, in turn, opens out into two rear gun positions behind the main planes. There is a through passage from bow to stern of the hull. Hammocks can be slung, so that the crew of five can sleep on board and remain afloat for long

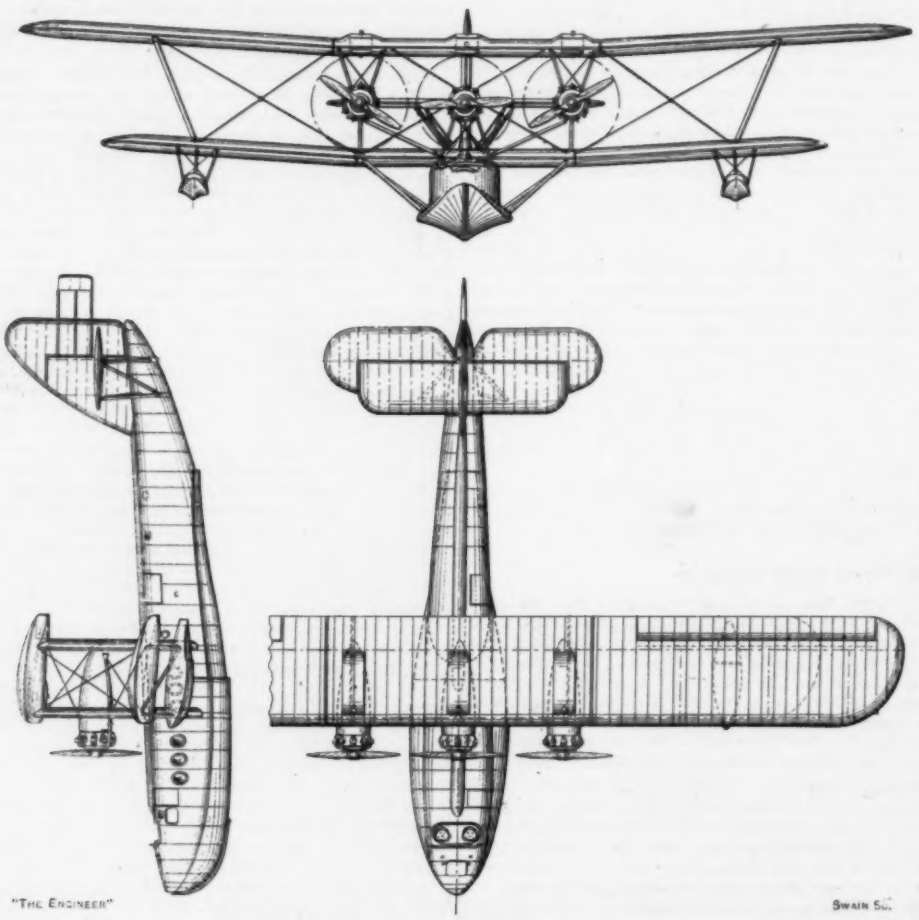
periods. The machine can be flown, manœuvred and turned with only one engine in action. When fully loaded it has a weight of 14,300 lb. Its length is 49ft. 8in., its height 18ft. 7in., and its span 75ft. Its maximum speed is 108 miles an hour, and its landing speed 52 miles an hour. It can climb to 5000ft. in 10 min., and has a ceiling of 14,000ft. In addition to the production of Southampton flying boats, the Supermarine Company during the year was engaged upon a large flying boat, to be fitted with three "Jaguar" air-cooled engines, for the Royal Danish Navy. The firm also increased its facilities for metal construction work, so as to be in a position to supply machines either of wood or of metal.

Short Bros., Ltd.—For many years now Short Bros., Ltd., of Rochester, have been prominently identified with the "all-metal" form of aeroplane construction. The firm's pioneer work in this direction is, we are glad to learn, now receiving a satisfactory measure of official encouragement. During the past year Messrs. Short delivered to the Government the largest all-metal flying-boat as yet made in this country. This machine is still on the secret list, but we gather that its construction follows the lines of the design illustrated in our issue of January 5th, 1923. It is now undergoing its official tests. From the firm's own trials the opinion has been formed that the machine represents a remarkable advance in flying boat design, and that it opens the way to a considerable development in the size, carrying capacity and range of flying boats constructed throughout of metal. Another design of all-metal flying boat upon which the firm is at present engaged is illustrated herewith. Two of the large all-metal passenger carrying flying-boats, illustrated in the drawing, are now under construction in the firm's shops for Imperial Airways, Ltd. These machines, to be known as the Calcutta type, are made with spars and ribs of duralumin and stainless steel fittings throughout. The wing covering is of fabric and not of metallic sheeting, as in the firm's earlier all-metal machines, such as the "Silver Streak." The propellers are of metal of the form described below, and the rudder is operated by a servo-motor. The machines are to be driven by three Jupiter Mark VI. engines. The span is 93ft., the overall length 65ft., and the overall height 22ft. 3in. The wing chord measures 11ft. 6in. They carry a crew of three and fifteen passengers, and, when fully loaded, each weighs 19,600 lb., of which 3540 lb. is paying load. In the fully loaded condition the designed maximum speed is 105 knots, the landing speed 46 knots, and the range 545 miles. The all-metal twin-float sports and training seaplane known as the "Mussel," which we illustrate in a Supplement, is another of the firm's productions during the year. The design of this machine was undertaken with the object of developing a thick-wing monoplane possessing special qualities of stability in the air. Because of the considerable unknown scale effect which affects all model experiments, it was decided to build a small full sized machine straight away rather than incur the expense and uncertainty of wind tunnel experiments. In the "Mussel" as built, the fore-and-aft lateral and directional stability, we are informed, is of a remarkably high order. The wing shape and the general disposition of the weights and surfaces effect, we learn, the elimination of any tendency to nose diving after a "stall" and maintain the aileron control when the machine is in the stalled condition. The "Mussel" has a span of 36ft., an overall length of 25ft. 3in., and an overall height of 10ft. 9in. The chord of the wings measures 6ft., and the gross weight is 1430 lb. Fitted with a Mark I. "Cirrus" engine, the machine has a maximum speed at sea level of 85 miles an hour, a landing speed of 42 miles an hour, and an initial rate of climb of 360ft. per minute. With the improved design of "Cirrus" engine giving an additional 18 horse-power, the performance, it is anticipated, will be even better. In particular the rate of climb will be nearly doubled. In addition to building all-metal flying boats and seaplanes, Messrs. Short during the year did a considerable amount of business in supplying metal floats to other aircraft firms. A noteworthy instance of this co-operation resulted in the successful conversion of the de Havilland "Moth" into a seaplane. The firm also supplied the metal floats which Sir Alan Cobham used on his de Havilland machine during a portion of his flight to Australia and back. The Short patented metal propeller, illustrated herewith, is a noteworthy development produced by the firm. It is claimed that this propeller is simple and cheap to make, as compared with other forms of metal propeller on the market. It is made of solid duralumin. The blades are detachable at the boss to facilitate storage and replacement. Tests, we are informed, have shown that with this type of metal propeller greater speeds and rates of climbing are obtained than can be secured with the best wooden propellers. In the case of the "Mussel" seaplane the change improves the speed by about 3 miles an hour. The propeller, although slightly heavier than an equivalent wooden one, has a higher efficiency.

Hawker Engineering Company, Ltd.—The Kingston-on-Thames works of the H. G. Hawker Engineering Company, Ltd., were engaged throughout the year entirely on production for the Royal Air Force. The machines produced were principally "Woodcock" night-flying single-seater fighters and "Horsley" day bombers. Both these types were referred to in our review a year ago, and no additional information concerning their design or performance can yet be disclosed. The "Danecock" machine—illustrated in a Supplement—is, we infer, a foreign-built example of the "Woodcock" type which we briefly described, but did not illustrate, last year. It has been built in

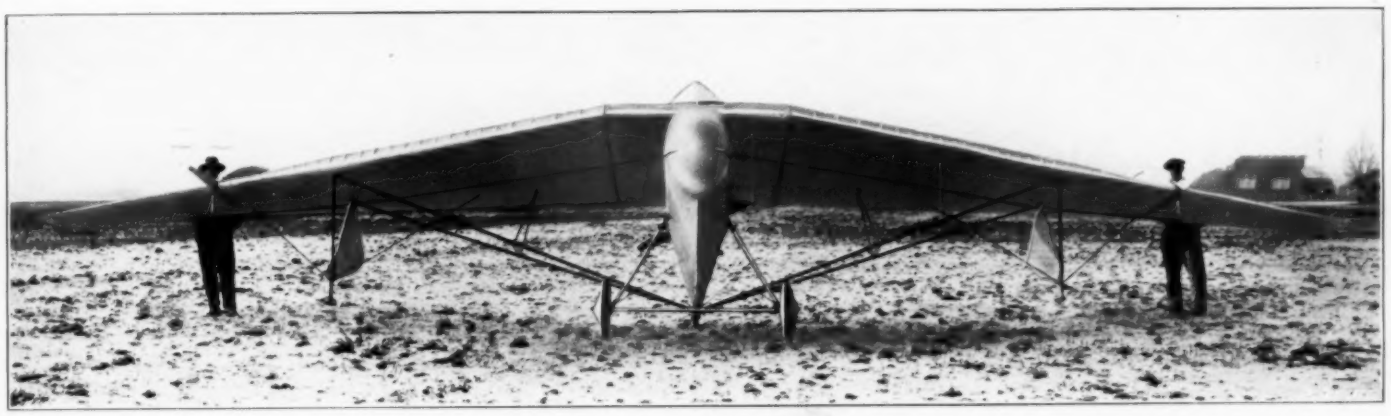


SHORT BROS. DURALUMIN PROPELLER WITH DETACHABLE BLADES



SHORT BROS. ALL-METAL "CALCUTTA" FLYING BOAT

SOME AEROPLANES OF 1926

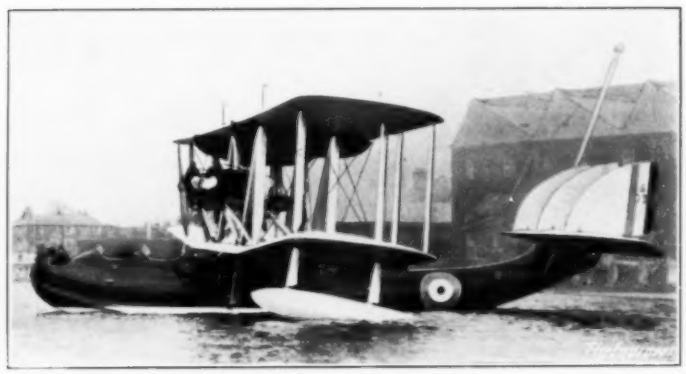


THE HILL "PTERODACTYL" OR TAILLESS AEROPLANE

HANDLEY PAGE "HAMLET" FIVE-SEATER MONOPLANE

SHORT BROS. "MUSSEL" ALL-METAL SEAPLANE

HAWKER "DANECOCK" SINGLE-SEATER FIGHTER

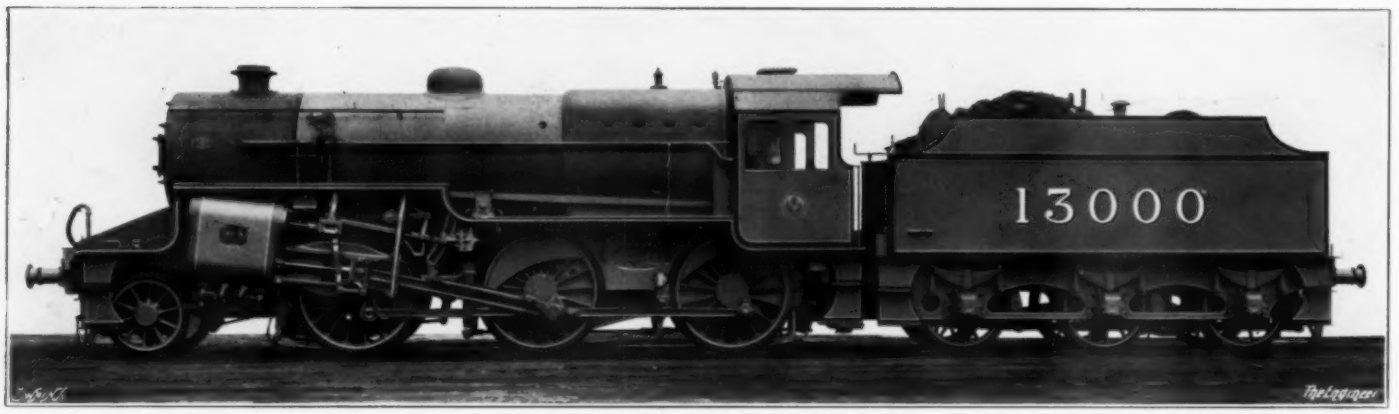


SUPERMARINE "SOUTHAMPTON" FLYING BOAT

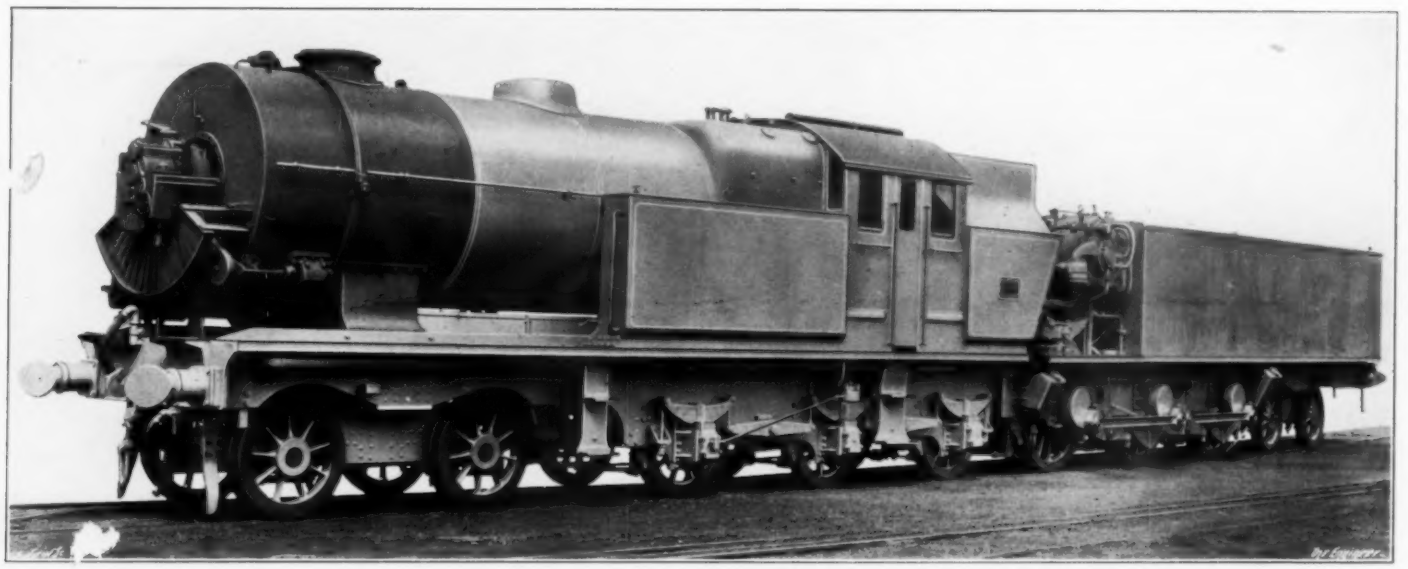
VICKERS-WIBAULT ALL-METAL SINGLE-SEATER SCOUT

SOME LOCOMOTIVES OF 1926.

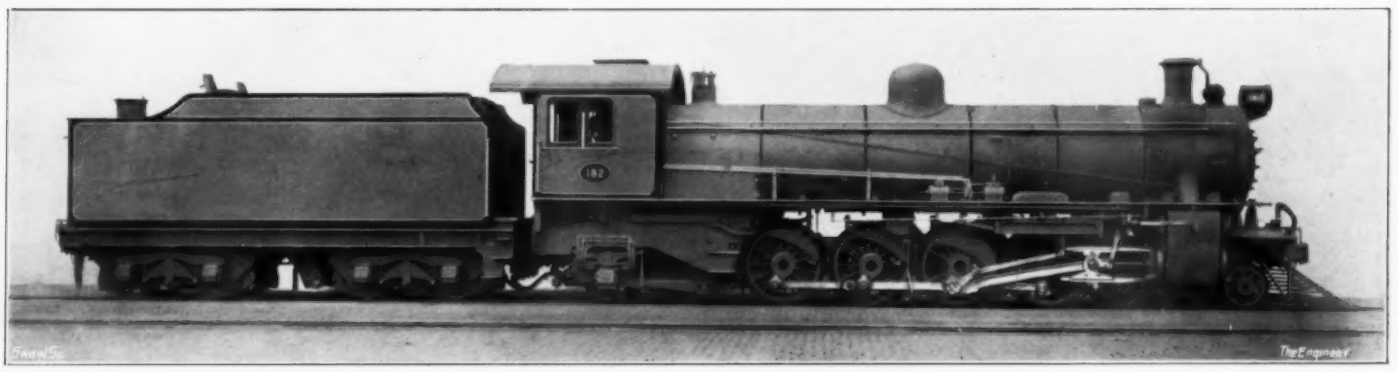
SOUTHERN RAILWAY—FOUR-CYLINDER EXPRESS PASSENGER ENGINE



LONDON, MIDLAND AND SCOTTISH RAILWAY—MIXED TRAFFIC ENGINE

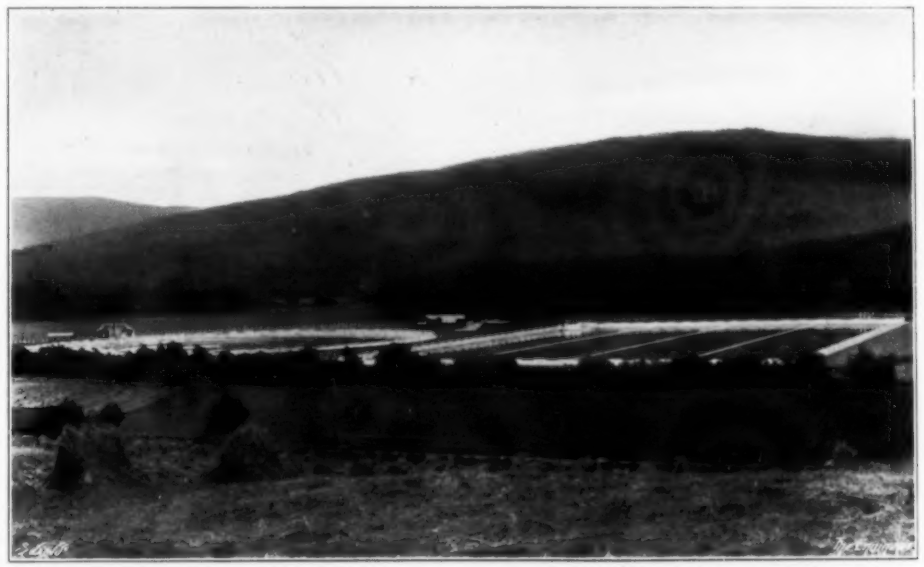


LJUNGSTROM TURBINE LOCOMOTIVE—BEYER, PEACOCK



RHODESIAN RAILWAY LOCOMOTIVE WITH LENTZ VALVES—NORTH BRITISH LOCOMOTIVE CO.

SOME CIVIL ENGINEERING WORKS OF 1926



ABERDEEN WATER SUPPLY—OLD AND NEW RESERVOIRS AT INVERCANNIE

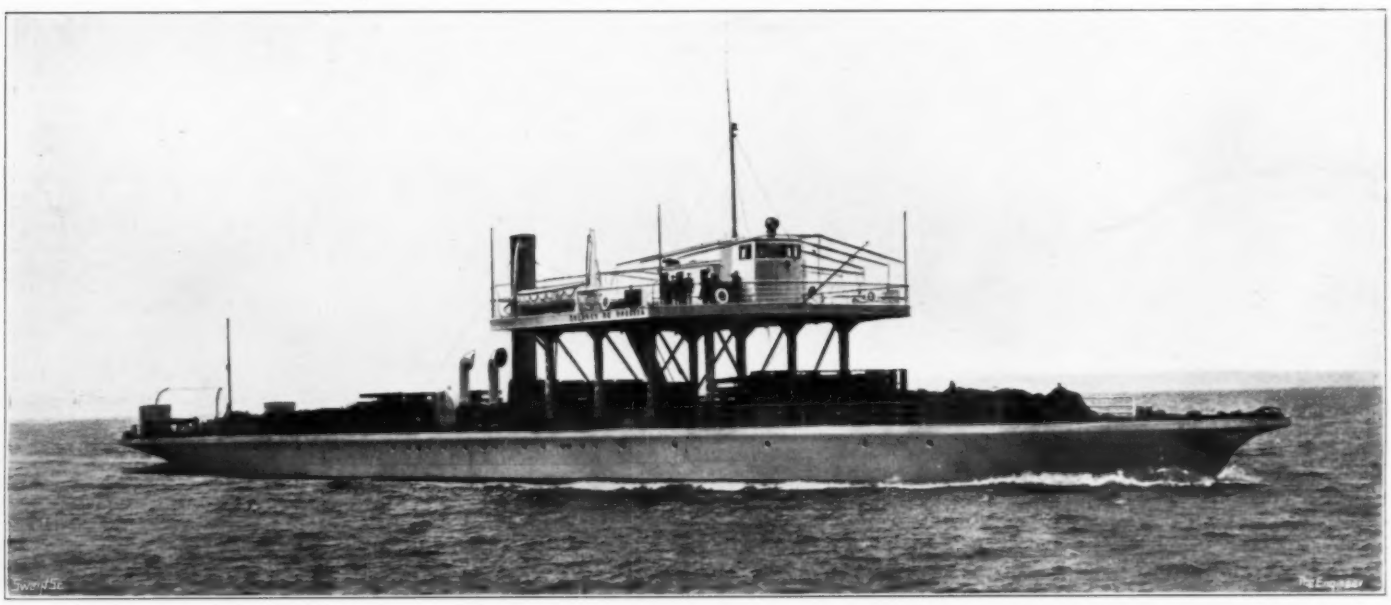
METROPOLITAN WATER BOARD—NEW FILTRATION PLANT AT WALTON

DRY DOCK AT ESQUIMALT

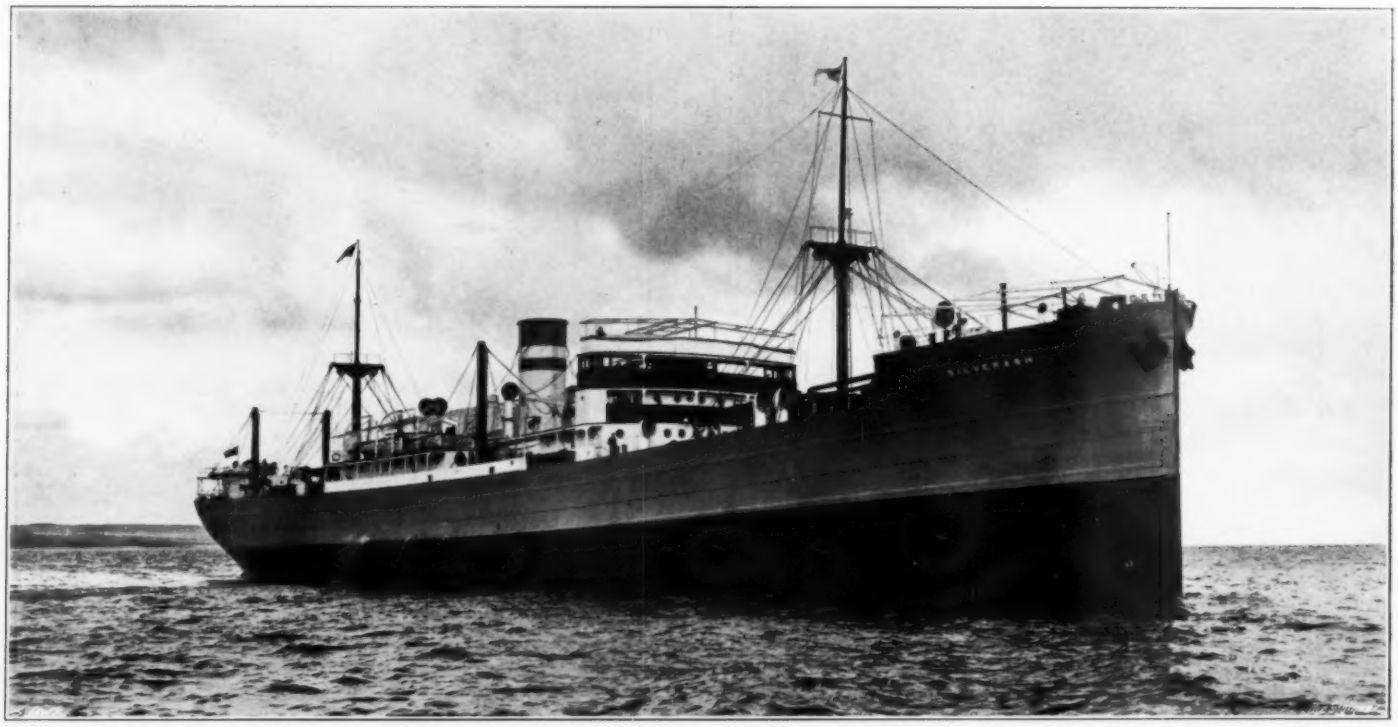
FLOATING ROADWAY AT SEACOMBE FERRY

SOME MOTOR SHIPS OF 1926

THE MOTOR PASSENGER LINER CARNARVON CASTLE



THE MOTOR TRAIN FERRY DOLORES DE URQUIZA

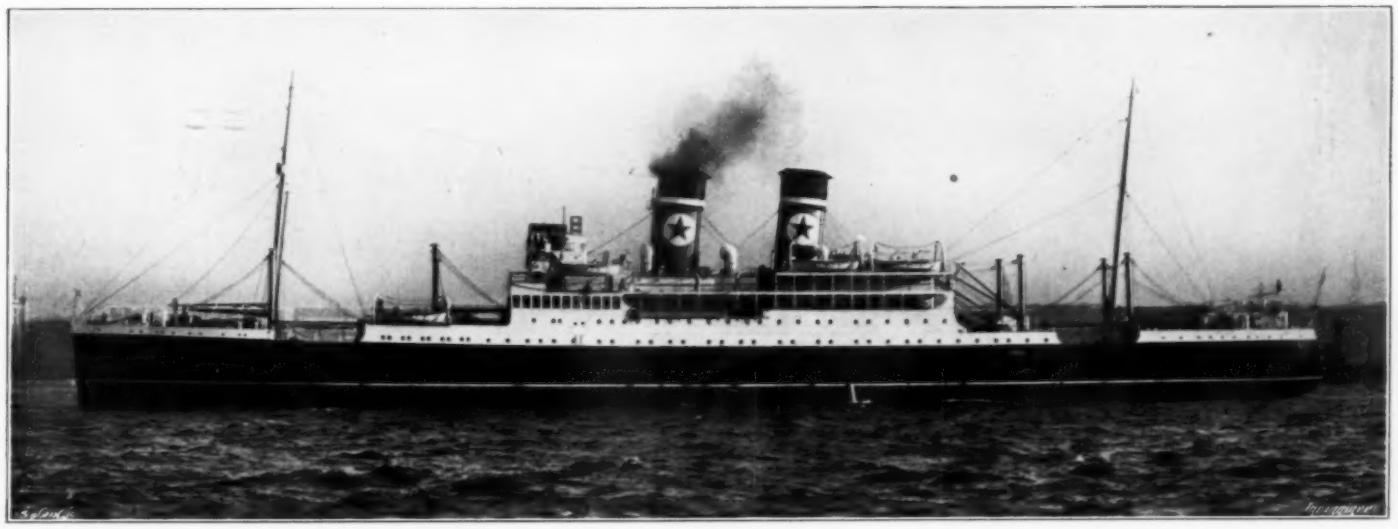


THE SILVER LINE MOTOR CARGO SHIP SILVERASH

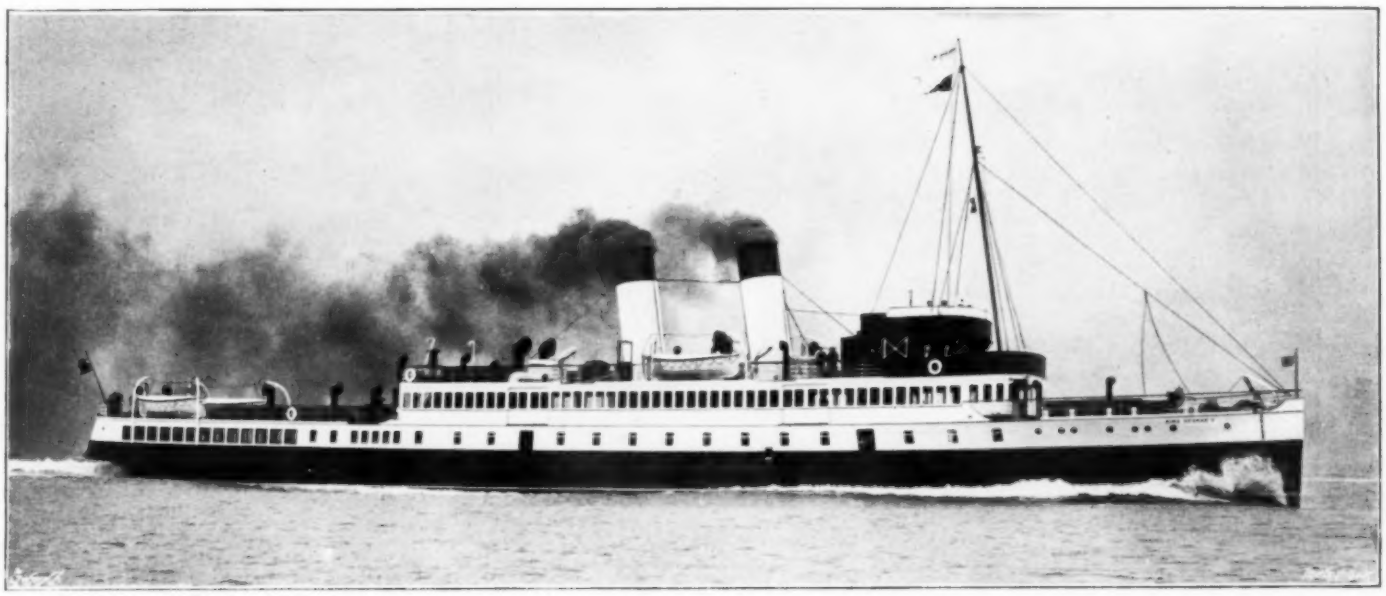
4th MAY,

Y, 1926.

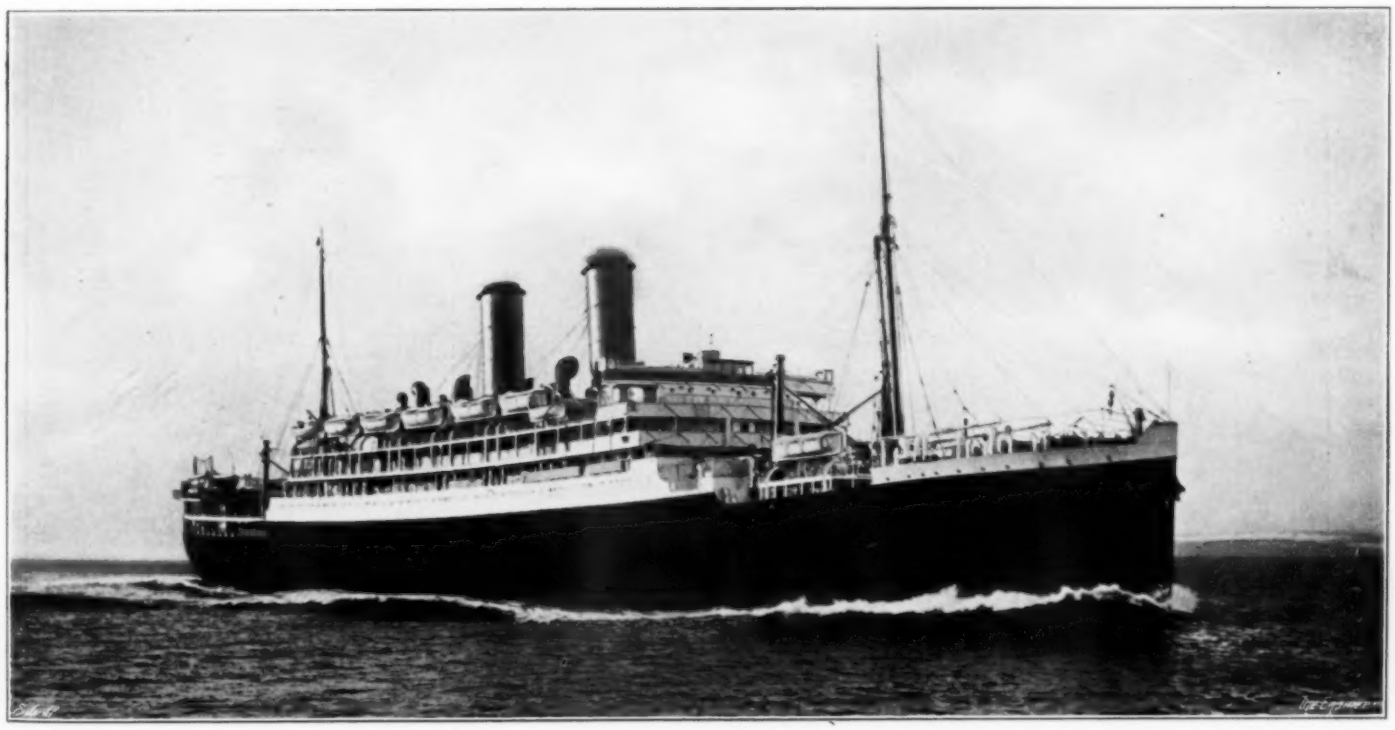
SOME STEAMSHIPS OF 1926



THE BLUE STAR LINER ALMEDA

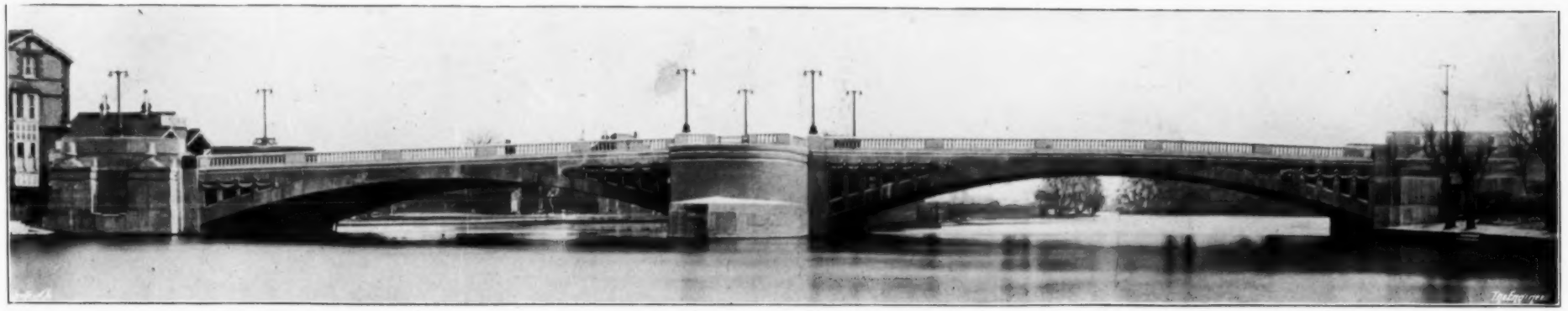


THE HIGH-PRESSURE GEARED TURBINE CLYDE STEAMER KING GEORGE V.



THE ORIENT LINER OTRANTO

SOME BRIDGES OF 1926



BRIDGE OVER THE THAMES AT CAVERSHAM

VIADUCT OVER THE LEA MARCHES NORTH CIRCULAR ROAD

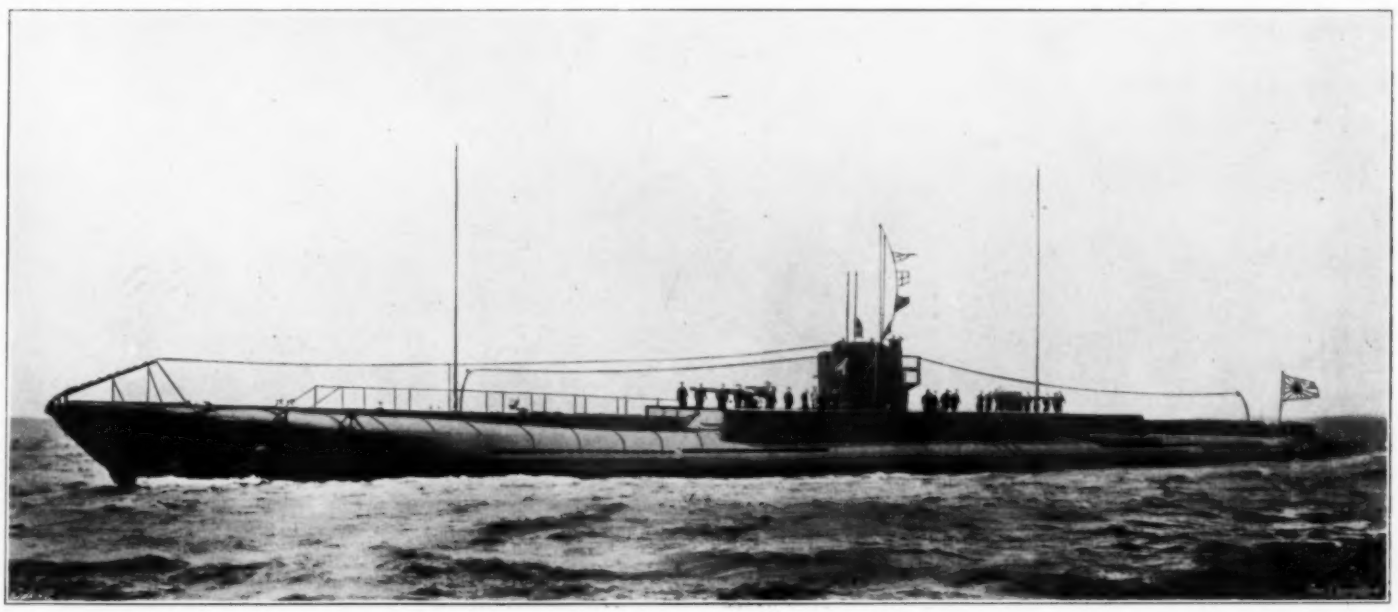
DRAWBRIDGE AT KEADBY, L. AND N.E. RAILWAY

BRIDGE OVER THE TWEED AT BERWICK

SOME WAR VESSELS OF 1926

THE FRENCH CRUISER DUGUAY-TROUIN

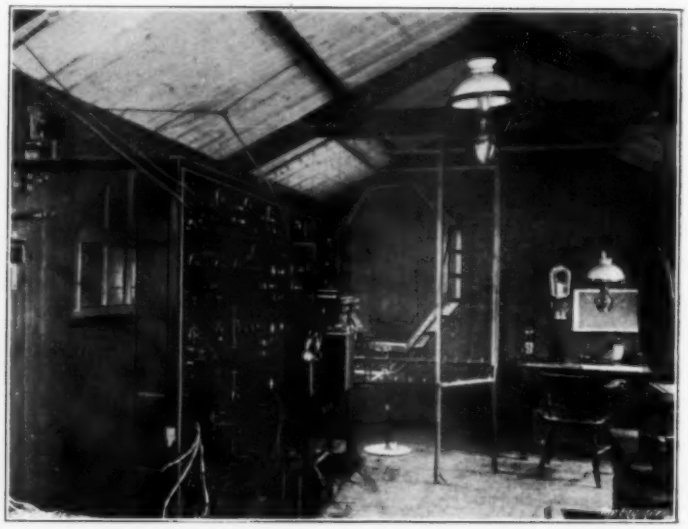
THE JAPANESE CRUISER FURUTAKA



JAPANESE MINELAYING SUBMARINE

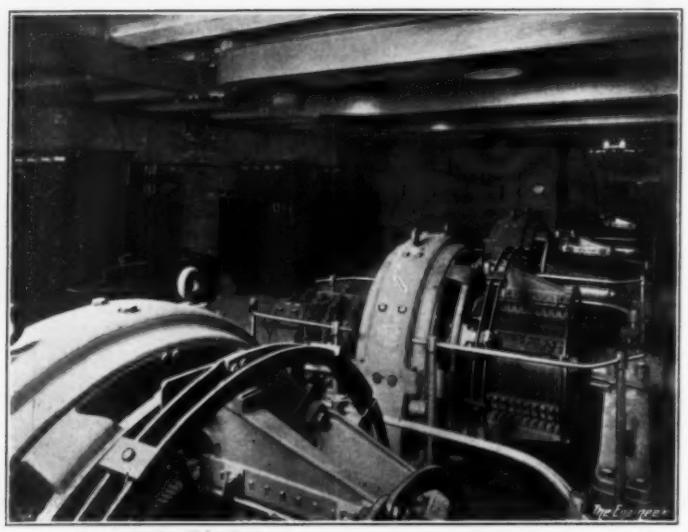
ELECTRICAL ENGINEERING IN 1926

TRANSATLANTIC WIRELESS TELEPHONY TRANSMITTER AT RUGBY

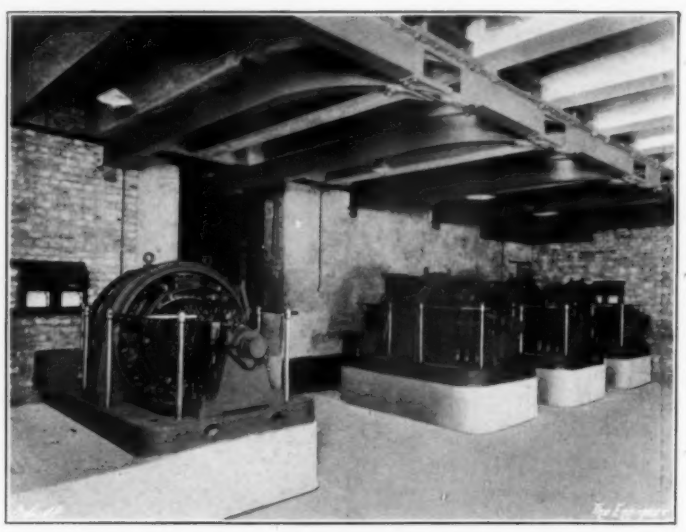


TRANSATLANTIC WIRELESS TELEPHONY RECEIVING HUT AT WROUGHTON

MACHINERY HALL OF THE BODMIN WIRELESS BEAM TRANSMITTING STATION

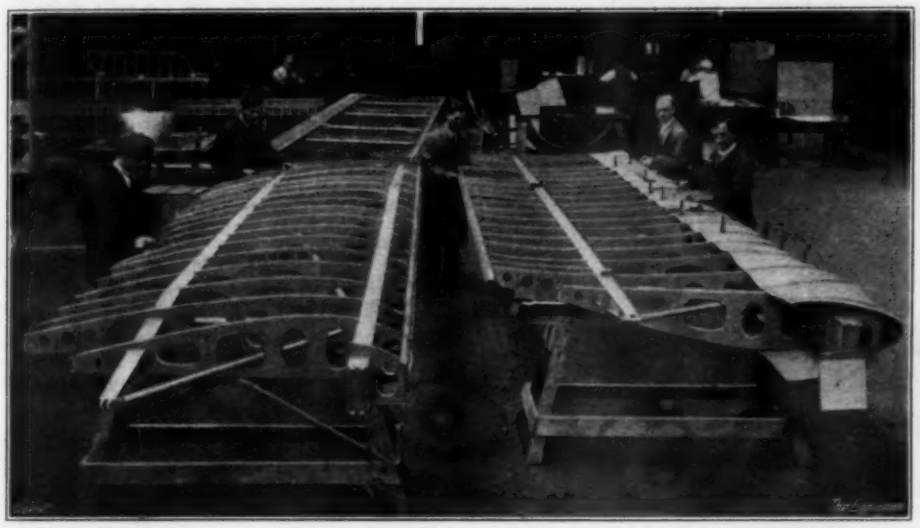


SOHO SQUARE AUTOMATIC SUB-STATION



ROTARIES AT SOHO SQUARE SUB-STATION

quantities at the Royal Danish Dockyard for the Royal Danish Navy, and has, we are informed, proved very successful. It is fitted with a "Jaguar" engine instead of the Bristol "Jupiter" used in the British prototype. The "Heron" machine illustrated twelve months ago was further developed. It is a single-seater fighter of metal construction, driven by a "Jupiter" engine. Its structure is based on an extremely light tubular system, which dispenses with the use of high tensile steel strip and duralumin. The design has been specially developed to meet the requirements of mass production. A new Hawker machine, the "Hornbill"—illustrated on page 16—made its first public appearance in the summer. It

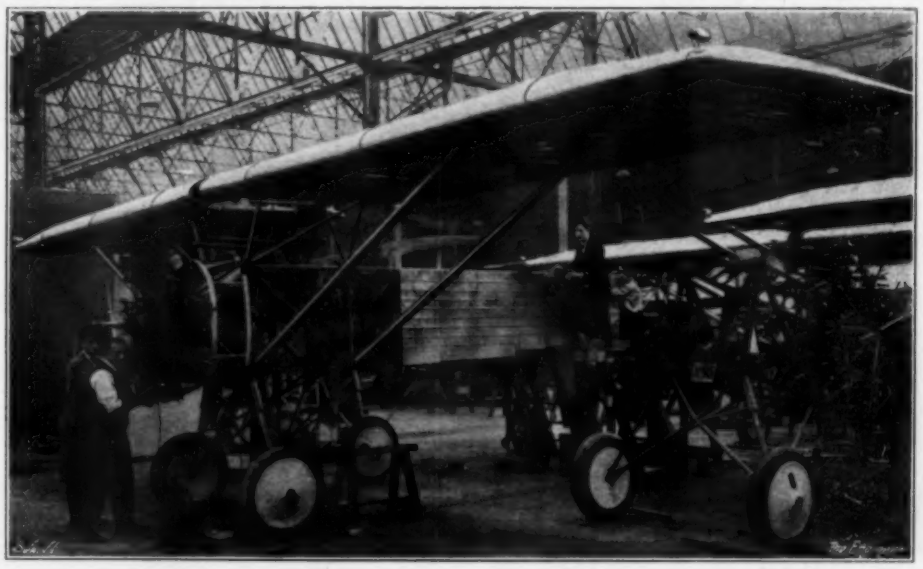


VICKERS - WIBAULT ALL - METAL WINGS

is driven by a Rolls-Royce "Condor" engine of 650 horse-power, and is claimed to be the most powerful single-seater fighter in the world. A special system of controls renders it, it is said, controllable at all speeds. The "Hornbill" is now undergoing extensive tests at Martlesham Heath. In the experimental shops the firm has three new types of machine under construction for the Air Ministry.

Vickers Ltd.—The Weybridge works of Vickers Ltd. were actively engaged during the year on the production for the Air Ministry of "Virginia" night bombers and "Victoria" twenty-four-seater troop carriers. Both these allied designs have been described and illustrated in previous reviews. In connection with the "Virginia" machine developments were made to improve its defensive and attacking capacity. In addition, an all-metal duralumin cellule is being built for it as an experiment, which, it is expected, will economise weight to the extent of several hundred pounds. The "Vendace," an advanced training two-seater biplane, the beginning of the construction of which was mentioned in our last review, was completed during the year, and is illustrated on page 16. The machine has been tested as a land plane and preparations have been made to try it with an all-metal twin-float chassis. When fitted with a Rolls-Royce 290 horse-power "Falcon" engine the machine was found to have the large reserve of power necessary to give a rapid take-off from the deck of a ship. After landing on the deck it was found that the machine pulled up quickly and did not show any tendency to sway. Tandem seating and dual control are provided. A special feature is to be found in the adjustable seats, which can be raised or lowered during flight to give the pilot, at will, either the maximum angle of vision when alighting or taking off or the maximum amount of protection in normal flight. The "Vespa" machine, of which a photograph is reproduced on page 16, is an Army co-operation two-seater aeroplane produced during the year. It has been specially designed for reconnaissance duties, and is claimed to possess in an outstanding degree the necessary qualities of quick take-off, low landing speed, high service ceiling, steep gradient of climb, and great manœuvrability at all heights. In its construction duralumin has been employed to the virtual exclusion of wood. The machine is driven by a Bristol "Jupiter" engine. It can climb to 14,760ft. in 19·5 minutes and at that height has a full speed of 120 miles an hour. Its minimum speed is 44 miles an hour. The performance of this machine may be compared with that of another design produced by the firm as an experiment of its own. This machine, of which no illustration is yet available, is a single-seater fighting biplane. Its structure is almost entirely of duralumin, and its engine is a French Hispano of 480 horse-power. Flight trials are now in progress. Subject to verification, the machine can climb to 14,760ft. in twelve minutes and has a speed at that height of 144 miles an hour. Its minimum speed is 50 miles an hour. Under licence from Avions Michel Wibault, the firm produced for a foreign Government a number of single-seater monoplane scouts fitted with Bristol "Jupiter" engines. This type of machine, of which we give a general view in a Supplement and two constructional views herewith, is entirely of metal—duralumin—construction, even the wing covering being metallic. The undoubted advantages of all-metal construction may readily be nullified by certain defects. Even if the weight is not increased and the cost not rendered prohibitive, the complexity of the structure may be objectionable and the difficulties of inspection and repair may be very great. These defects, it is claimed, are all avoided in the Wibault patented system of construction. Facility of repair, probably the most crucial feature in an all-metal machine, particularly in one with metallic wing coverings, is secured by arranging the riveted fastenings with both heads of each rivet visible. This feature has been studied to such an extent that throughout the machine there are only some 10 per cent. of the rivets that are not visible at both ends. The coverings for the wings, flying organs and body are made of corrugated plates. In the case of the wings and flying organs the covering plates are united by rivets passing through upstanding longitudinal ribs at the edges of the plates. The fuselage structure is carried out in duralumin members of L and T section jointed by flitch plates. The wing spars are of box section and are braced by a system of diagonal tubes. The ribs are made of duralumin sheet pierced with lightening holes and riveted to the spars by means of small angles. Since all the riveting is done from the outside, it is readily possible to repair a damaged portion of the covering by riveting on a patch. Tail adjustment gear is provided. The two wheels of the oleo undercarriage can move independently. The machine illustrated has an overall length of 25ft. 8in., an overall height of 9ft. 6in., and a span of 36ft. 1in. Its loaded weight is 3060 lb., of which 1087 lb. is useful load, the remainder 1973 lb. being the weight of the machine bare. It can climb to 14,760ft. in 11·5 minutes, and at that height has a full speed of 139 miles an hour. Its minimum speed is 55 miles an hour. From these notes on Messrs. Vickers' work during the year it will be observed that, like almost the majority of aeronautical firms, the company is taking increasingly to metallic construction. Experiments with duralumin airscrews are now in progress, and in the near future a settled policy in this direction may be expected.

Westland Aircraft Works, Ltd.—The Westland Aircraft Works at Yeovil, a branch of Petters, Ltd., was engaged during the year on building and reconditioning a number of D H 9 A machines, a wartime design which is still used in large degree as a day bomber and for general purposes. In addition to experimental machines for the Air Ministry, concerning which nothing may be said, the firm did a considerable amount of work in the development of machines as a matter purely of private enterprise. An interesting example of a machine of this class now under test is a single-seater fighter, which it is intended ultimately to fit with a supercharged engine. This machine is a "parasol" monoplane. The wing section, developed in the firm's own wind tunnel, gives a very low resistance at high speeds, and a very small shift of the centre of pressure. The greater part of the fuselage is of metal construction, and a special type of joint has been developed to enable any damaged member to be easily replaced. The petrol is fed by gravity from tanks situated in the wings. The cooling of the engine is effected by means of a retractable radiator. Landing shocks are taken on an oleo-pneumatic undercarriage. For the time being, while the delivery of the engine finally to be fitted is being awaited, an engine of less than the intended power has been installed. The machine in this condition has been flown and has given results which, we are informed, are well up to expectations. During the year Captain G. T. R. Hill joined the firm's staff, and is now engaged in the development of his tailless aeroplane. Captain Hill's experimental machine is illustrated in a Supplement. It was shown on test to be quite controllable at speeds and in positions which would be very unsafe were the design normal. The machine illustrated is a two-seater driven by a Bristol "Cherub" engine of 36 maximum brake horse-power. The leading edge of the main plane is swept back 31 deg., and the trailing edge 14 deg. There is no dihedral angle, and the incidence suffers a wash out of 6 deg. between the root and the tip of the wing. The controlling organs consist of controllers taking the place of the normal ailerons, and a rudder beneath each wing, the rudders being arranged to operate separately or in unison, in which case they serve as air brakes. The overall span is 45ft. In flight it was found that the machine was under good control, even at angles of incidence as great as 45 deg. The speed attained was 70 miles an hour, and the stalling speed was estimated at 29 miles an hour. There is, however, no marked division between stalled and normal flight, and the pilot can unstall the machine without diving to recover speed. The Westland Works, in addition to these activities, continued to develop the Yeovil day-bomber illustrated in our review a year ago, and the Widgeon light aeroplane, which we dealt with two years ago. An improved design of the Widgeon machine fitted with an Armstrong-Siddeley "Genet" engine, showed itself to be the fastest machine entered for the Grosvenor Cup Race of 1926, its speed averaging 105·5 miles an hour. A further improvement is now in hand, in which the engine will be a Cirrus Mark II. The machine will carry pilot, passenger and luggage, and will have folding wings to enable it to be housed in an ordinary garage.



VICKERS - WIBAULT ALL - METAL MONOPLANE SCOUT

THE output of coal from the mines of Great Britain during the week which ended on December 25th was 4,651,500 tons.

Steamships and Steam Marine Engineering in 1926.

THE world depression in shipbuilding and marine engineering was reflected in all centres of British shipbuilding industry, some of which, however, fared better than others. Thus the output on the Clyde was more marked than that on the Tyne, whilst the Tees compared advantageously with the Wear. On the Mersey there was considerable activity. Throughout the year there was a better spirit in the relations between shipbuilding employers and the trade unions, largely on account of the continued joint inquiry into shipbuilding conditions and the ratification of the agreement for the settlement of trade disputes. Increased output was, however, negatived to a large extent by the failure of supplies of shipbuilding material during several months. In some cases important orders could not be begun for lack of steel and fuel. Yet, although the past year will rank as a poor one in the annals of the industry, its passing was marked by the completion of some notable vessels and important technical advances were made.

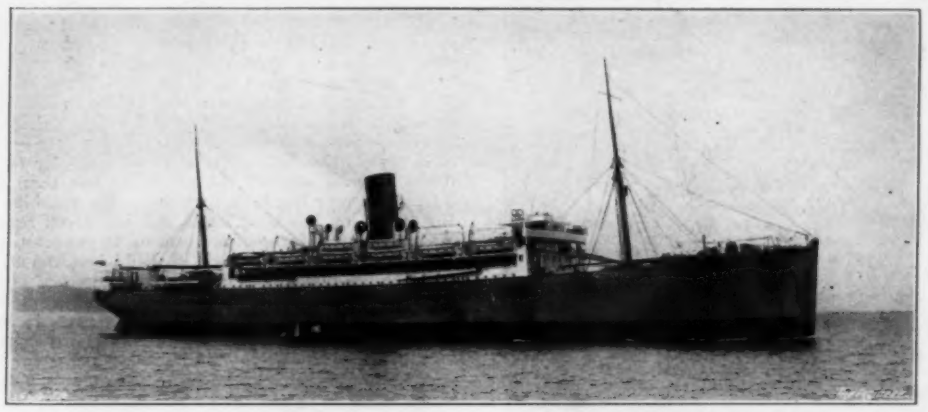


FIG. 1—THE UNION CASTLE LINER LLANDAFF CASTLE

Higher Steam Pressures and Temperatures.

The year 1926 will be associated with the advance made in the direction of the utilisation of higher steam pressures and temperatures for marine turbine machinery. In adapting such pressures marine engineers are only following recognised power station practice, which has proved successful. It was the recognition of such experience that, we believe, prompted Canadian Pacific Steamships, Ltd., to place with John Brown and Co., Ltd., and William Beardmore and Co., Ltd., orders for two 17,500-ton passenger liners, which will be engined with steam turbine machinery working at a pressure of 350 lb. per square inch, steam being supplied from a combination of oil-fired Yarrow water-tube and Scotch boilers. Even more interest attaches to the five cargo ships to be built for the same owners by Barclay Curle, Dennys, and Armstrong-Whitworth. A steam pressure of 250 lb. has been chosen, but additional interest is added to the machinery installation by the use of Yarrow and Scotch boilers fitted with mechanical stokers. The impetus given to high-pressure work by these orders was increased by the excellent results obtained from the high-pressure geared turbine machinery installed by the Parsons Marine Steam Turbine Company, Ltd., in the Denny-built Clyde passenger steamer King George. A view of that notable vessel is reproduced in one of to-day's Supplements, and it may be recalled that we described the complete machinery installation in three articles which were published in our issues of September 10th, 17th, and 24th. Steam is supplied to the turbines from a high-pressure Yarrow boiler designed for 550 lb., the total superheated steam temperature being 750 deg. Fah. The turbines are geared to two shafts and they have a designed output of 3500 S.H.P. During the trial runs, which took place in September and December, the machinery ran smoothly and without incident, and the results are stated to confirm all the economies which were expected by the builders. On the last trial the boilers showed an efficiency of 80 per cent. when hand fired with coal from Polmaise Colliery. Full details of the performance of this ship are to be given in a paper to be read before the North-East Coast Institution of Engineers and Shipbuilders early in January. Another high-pressure installation was completed for the Ellerman liner City of Bath, in which quadruple-expansion engines designed for a working pressure of 265 lb. per square inch were installed. The machinery and auxiliaries were constructed by the Central Marine Engine Works at West Hartlepool and include air preheaters and high-pressure feed heaters.

Some Notable Ships of the Year.

In a Supplement to-day we illustrate the 20,000-ton Orient liner Otranto, which was built by Vickers Ltd. and placed in commission early in the year. She is a twin-screw passenger steamship of the "Orama" type and is engined with geared Parsons impulse and reaction type turbine machinery of 19,500 S.H.P., steam being supplied from oil-fired boilers at 215 lb. pressure. It will be recalled that on the high-power trial of her sister ship Orama the excellent figure of 0·785 lb. of oil per S.H.P. was obtained. The same builders have on order a third ship, the Orford. In this vessel the arrangement of boilers will be altered to give room for an open-air swimming bath. Vickers Ltd. also completed the Nova Scotia for the Warren Line, Ltd., of Liverpool.

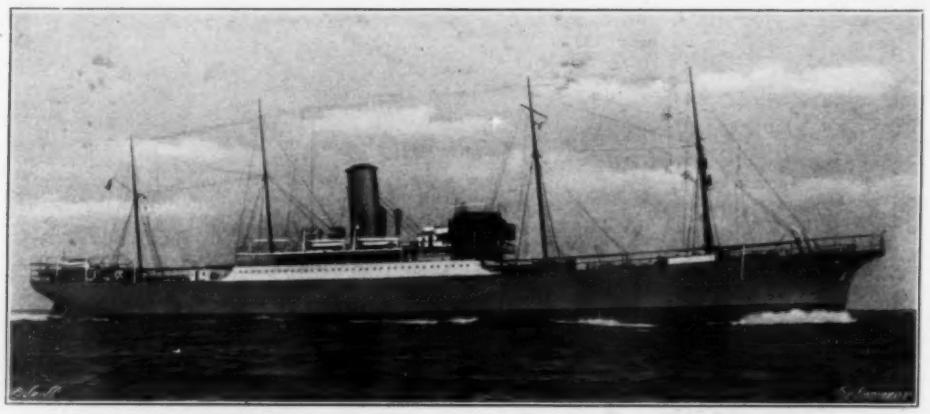


FIG. 2—THE CABLE LAYING STEAMER DOMINIA

Another passenger liner which figures in to-day's Supplement is the Almeda, the first of the five passenger-carrying refrigerated ships ordered by the Blue Star Line (1920), Ltd. A full account of this ship and her propelling machinery was given in our last issue. The propelling machinery comprises a twin-screw arrangement of single-reduction geared turbines which have a designed output of 7600 S.H.P. A feature of the ship is the size of the refrigerating machinery and the very complete arrangement for the carriage of chilled meat. The Almeda was built and engined by Cammell Laird and Co., Ltd., at Birkenhead, and during the year the sister ship, the Andalusia, was launched. A third liner, the Arandora, was launched on January 4th.

At the Clydebank Yard of John Brown and Co. two other Blue Star liners, the Avila and Avelon, are being built. Further down the Clyde, at the Port-Glasgow Yard of Lithgows, Ltd., two 10,500-ton Blue Star insulated twin-screw cargo steamers, the Rodneystar and the Raleighstar, were launched. This firm launched ten ships during the year with an aggregate tonnage of 63,325 gross. The twin-screw turbine, 7350 S.H.P. machinery for these vessels was constructed at Greenock by John G. Kincaid and Co., Ltd. At the Hebburn Yard of Palmers Shipbuilding and Iron Company, Ltd., two other Blue Star cargo vessels were launched and engined; they were the Stuartstar and the Africstar. Another notable ship, completed by Palmers, was the British Inventor, the first tanker to be built on the Isherwood bracketless system. In this vessel the longitudinals of the ordinary Isherwood system are not connected by the large flanged brackets at the bulkheads, but at the sides, bottom and decks of the ship, the ends of the longitudinals are sniped off, which results in a very considerable saving in the plating and riveting work throughout the vessel.

In Fig. 1 we show the new Union-Castle liner Llandaff Castle, which was built and engined by Workman, Clark and Co., Ltd., at Belfast. She is a 490ft. ship with a measurement of 10,000 gross tons, and is designed to carry first and third-class passengers. The propelling machinery consists of two sets of quadruple-expansion engines which are balanced on the Yarrow-Schlick and Tweedy system and are designed to develop over 6000 I.H.P. Steam is supplied from three double and two single-ended multitubular boilers. Our second illustration, Fig. 2, shows the cable steamer Dominia, which was built by Swan, Hunter and Wigham Richardson, Ltd., for the Telegraph Construction and Maintenance Company, Ltd., of London, and in September sailed from the Thames to take part in an important cable-laying expedition. In appearance the ship is not unlike a large yacht; with her cut-water stem and four pole masts with a single raked funnel, she is particularly attractive. The Dominia has a length of 509ft., with a gross tonnage of 9250, and a 12,000-ton deadweight carrying capacity. She attained a speed of 14½ knots on trial and her propelling machinery comprises two sets of triple-expansion engines, steam being raised in five oil-fired boilers. There are four main cable tanks and the ship can carry over 8500 tons of cable, which can be laid at speeds up to 200 miles per day.

Another ship, also built at Swan, Hunter's yard, was the Ellerman liner City of Lyons, with Parsons type single-reduction geared turbines.

FIG. 3—CLAN MACNAUGHTON IMPROVISED STERN-FRAME

Repairs and Reconditioning.

Some interesting repairs were carried out during the period under review, and several ships were reconditioned for new services. We illustrate in Fig. 3 a repair job of more than usual interest, which was brought to light with the dry docking of the Clan liner Clan Macnaughton at the Elderslie Dry Dock of Barclay, Curle and Co., Ltd., Glasgow. Early in February last, while on her outward voyage, the ship ran aground off the Tasmanian coast and suffered severe damage to her hull. After being towed to Melbourne, the official repairers' union would not touch the ship unless permanent repairs were carried out. The engineers of the vessel decided to do the job themselves, and after getting together material they made the workmanlike job we show in Fig. 3. A stout girder was attached to the broken part of the stern frame at the keel plate and was carried out horizontally to join two vertical girders which were fixed to the remaining upright part of the stern frame. The rectangular frame thus formed was further stiffened at the corners by side plates. With the improvised stern frame shown above the Clan Macnaughton proceeded home under full power. The repair is one which bears testimony to the ingenuity

and resourcefulness of the chief engineer of the ship and his staff.

The usual liner overhauls were carried out during the year, and at Southampton the demands made upon the repairing yards of Harland and Wolff, Ltd., and John I. Thornycroft and Co., Ltd., were considerable. In order to equalise the work it was decided to send the Mauretania to Liverpool, where structural alterations are to be carried out by Houstons and the Cunard Company. Earlier in the year the Mauretania was overhauled by the Repair Department of John I. Thornycroft and Co., Ltd., at Southampton, as were also the Cunarders the Aquitania and Berengaria. In addition to these large liners twenty-four repairs were carried out on smaller ships. Thirteen liners and ships were dry docked, some more than

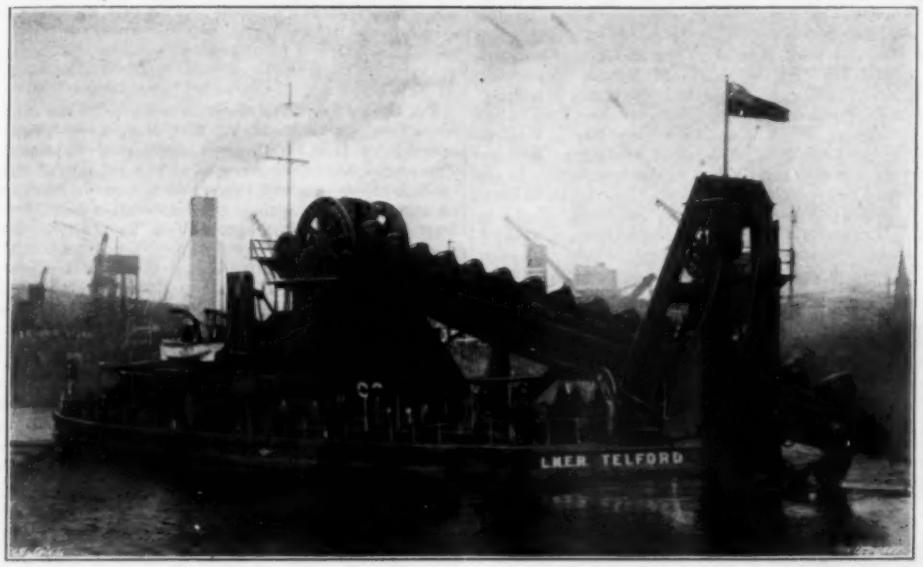


FIG. 4—L.N.E.R. BUCKET DREDGER TELFORD

once. At Harland and Wolff's Southampton yard several White Star liners were dealt with, while at the Belfast yard the twin-screw passenger liner Orduna was reconditioned and converted for oil firing prior to entering the South American service of the Pacific Steam Navigation Company, Ltd. At the Fairfield Shipbuilding and Engineering Company's yard at Govan, Glasgow, the Empress of Australia, of the Canadian Pacific fleet, is undergoing a thorough reconditioning and new propelling machinery is being installed. The Föttinger hydraulic transformer gear and German-built steam turbine machinery, which was described in our issue of July 7th, 1922, is being taken out and Fairfield-built steam turbines designed for a ship's speed of 18 knots are being installed. Several ships were repaired by Palmers on the Tyne.

Salvage Operations and Shipbreaking.

Noteworthy salvage operations were carried out at Scapa Flow in connection with the salving of the scuttled German fleet. Early in the year Cox and Danks, Ltd., completed their programme for the raising of the torpedo destroyer and work was begun on the battle-cruiser Hindenburg, it being sought to float the ship by patching and pumping out. A careful survey of the ship, which was aided by the finding of the flooding plans, was made. Owing, however, to a failure on the part of some water-tube boilers which furnished steam for the steam-driven alternators, it was not found possible to maintain the trim of the ship as she rose owing to the lack of sufficient pumping capacity. About the end of September work was abandoned on the Hindenburg and was begun on the upturned battle-cruiser Moltke, which, it is hoped, to float by means of compressed air admitted to the underside of the hull. With the return of favourable weather conditions it is intended to resume work on these vessels. There was no definite programme of shipbreaking during the year, and most of the vessels entering the shipbreakers' yards were naval ships which had been placed out of commission.

Some Dredgers of 1926.

On the Clyde particularly the year saw some activity in dredger building yards, and we show in the accompanying illustrations two Clyde-built ships of this type. Fig. 4 illustrates the L.N.E.R. bucket dredger Telford, which was completed by Lobnitz and Co., Ltd., for work at the Hull Docks. It is designed for a dredging depth of 40ft. and the capacity of the buckets is 18 cubic feet. In order to work at two speeds friction wheels and double helical gearing are fitted. The hull of the ship is subdivided so that in the case of accident ample stability and flotability are provided. On the trial of the Telford an output of nearly 1000 tons per hour was obtained, which, we understand, was considerably in excess of the specified requirements. Another dredger built by the firm is for tin mining at Tongkah Compound, N.L. It was built to the designs of F. W. Payne and Sons, of 62, London-wall, E.C. 2, and has a length of 158ft. with a moulded breadth of 50ft. and a moulded depth of 10ft. It has a bucket capacity of 9 cubic feet and is capable of dredging to a depth of 37ft. A revolving screen with upper and lower tables and the necessary chutes are fitted.

Our further illustration, Fig. 5, shows a twin-screw drag and cutter suction hopper dredger which was recently completed by Wm. Simons and Co., Ltd., of Renfrew, for the construction of a new harbour at Vizagapatam, from which it takes its name. It was built under the direction of Sir John Biles and Co., naval architects, to the order of the High Commissioners of India. The dredger has a length of 283ft. with a beam of 52ft. 6in. and a depth of 19ft. 6in. Its equipment includes 4000ft. of floating land discharge pipes for land reclamation work. Four sets of triple-expansion surface condensing engines are fitted, which may be employed to drive the propellers or dredging pumps as required. There are two sets of centrifugal dredging pumps and the equipment is designed to dredge to a depth of 45ft. under water. It has several interesting features, and is capable of being worked as a suction hopper dredger with moorings or as a drag suction hopper dredger without moorings, arrangements being made so that the cutter can be easily removed and replaced by the drag nozzle. Material may be discharged either through the pipe line, filled into the hopper and discharged at sea, or put over the side at a jetty. Two other smaller dredgers were also built for colonial work and three barges, while two self-propelling barges were constructed for British owners. At

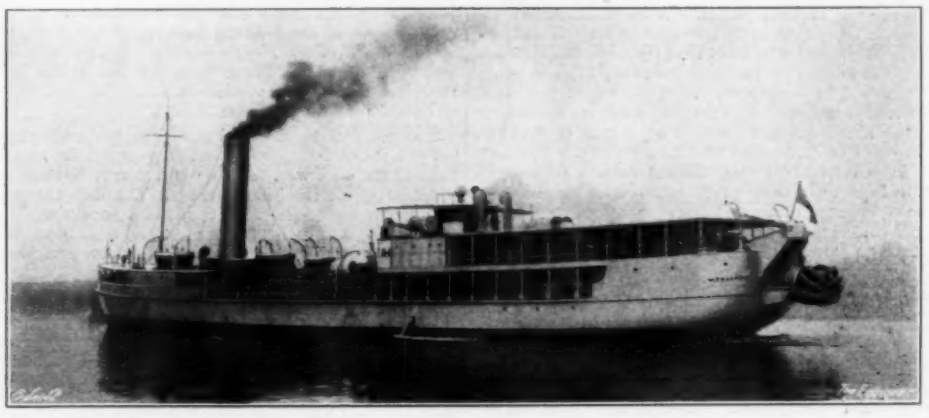


FIG. 5—DRAG AND SUCTION DREDGER VIZAGAPATAM

Paisley, Fleming and Ferguson, Ltd., delivered the Coquet Mouth, a 600-ton dredger for Newcastle-on-Tyne, while the machinery was finished for a Canadian Government dredger which was built in Canada. Ferguson Brothers (Port-Glasgow), Ltd., constructed a twin-screw self-propelling bucket hopper dredger for the service of the L.M.S. Railway Company at Grangemouth. It is designed to cut its own flotation and has a hopper capacity of 1200 tons. Three-crank triple steam engines built for 180 lb. pressure are fitted.

Large Liners Launched and Built Abroad.

With the prospect of the revival of the large passenger liner and increased international competition in the building of such ships, it is of interest to refer to the principal foreign-built liners of the year. At the Hamburg yard of Blohm and Voss, two Hamburg-American liners, the Hamburg and the New York, were launched. The former vessel was commissioned and the latter will enter the company's service in a few weeks. They are 600ft. 16-knot ships of 20,800 tons gross, designed to carry three classes of passengers, and are propelled by geared steam turbines. A feature of the design is the provision of bulges, in which anti-rolling tanks are embodied. On the sister ships of the "Albert Ballin" class, which are also fitted with this device, the angle of rolling is stated to have been reduced to less than one-third of that of a vessel without the tanks. At the close of the year the Norddeutscher Lloyd declared its intention of constructing two Transatlantic express liners of the "Columbus" type, with a gross tonnage of 46,000 each. In France the 40,000-ton quadruple-screw turbine ship, Ile de France, was launched at the yard of the Ateliers et Chantiers de St. Nazaire. A notable Italian liner of the year was the Roma, a 33,000-ton 700ft. liner designed for a service speed of 22 knots. She has Parsons single-reduction geared turbines, and was built and engined for the Navigazione Generale Italiana by G. Ansaldo and Co., of Sestri Ponenti, Genoa. The Roma will shortly be followed by the motor liner Augustus, her sister ship, which will be the largest quadruple-screw motor liner of the world. In America good progress was made with the Matson liner Malolo, a 22,000-ton 582ft. ship fitted with twin-screw steam turbines of 25,000 total S.H.P., designed to give the vessel a service speed of 21 knots. She is being constructed at William Cramp and Son's shipyard and engineering works, Philadelphia.

High Elastic Limit Steels for Shipbuilding.

There is evidence that high elastic limit mild steel will increasingly be used for shipbuilding and marine engineering. Such a steel having an elastic limit about twice that of ordinary mild steel, is that made from mild steel by the process of normalisation, which was introduced by Mr. F. G. Martin, the metallurgist to Alfred Holt and Co., and is manufactured by David Colville and Sons, Ltd., of Glasgow. The Holt liner Prometheus which has now been in service two years, is constructed of this new material, and service with her has shown, we learn, its reliable qualities. The use of this special steel enabled the builders to reduce the steel scantlings of the ship's structure, so as to obtain a gain of no less than 300 tons in the deadweight carrying capacity. Other similar vessels are now under construction. Tests have shown that this high elastic limit mild steel possesses homogeneous characteristics, which are the same along and across the direction of rolling. It is, moreover, very resistant to vibratory stress. On the important question of cost, it can be said that experience has demonstrated that the additional deadweight capacity gained by the use of the new steel is obtained at something like half the cost per ton of the deadweight in a steamer which is built of ordinary mild steel. At the end of the year Mr. T. M. Service, of William Beardmore and Co., Ltd., Parkhead, gave a paper on "High Elastic Limit Steel" before the Institution of Engineers and Shipbuilders in Scotland, in which he published particulars of tests carried out with an Admiralty unnormalised steel possessing a high limit of proportionality which, before testing, had undergone working under shipyard conditions. It seems probable that high elastic limit steel in one form or other will eventually replace ordinary mild steel as that material replaced iron.

Improved Marine Engine Efficiency.

We have already alluded to the adoption of higher steam pressures with air preheating and feed heating as a means of improving marine engine efficiency. The performance of the Ellerman liner the City of Bath will be awaited with keen interest, for with the machinery built by the Central Marine Engine Works,

of William Gray and Co., Ltd., of West Hartlepool, it is hoped with 265 lb. pressure steam used in quadruple-expansion engines to obtain a saving of 20 per cent. in coal consumption over that of the ordinary cargo steamer. The Plenty-Still engine, described in our motor ship article, also marks a step in this direction, although it is a combined oil and steam engine.

A considerable improvement in engine performance was obtained by use of the uniflow principle and the improved valve gears of the Lenz or Beardmore-Caprotti type, which also give a shorter engine.

Another attempt to provide an efficient steam installation for ships of small or medium powers emanates from Germany. It is of more than usual interest because it can readily be fitted to existing steamships. It is known as the Bauer-Wach system of a combined reciprocating engine and low-pressure turbine. The turbine drive is transmitted to the engine shaft by double-reduction gearing, with an intermediate Vulcan hydraulic-mechanical clutch. This arrangement was designed and built at the Joh. C. Tecklenborg shipyard and engine works at Bremerhaven-Wesermünde, and the set of machinery we illustrate in Fig. 6 was constructed for the fishing vessel Sirius, completed in September, which has since made several successful fishing trips, with a saving, it is stated, of 25 per cent. in coal consumption, as compared with a similar vessel fitted only with reciprocating engines. The turbine and gear unit is built on to the end of the engine, and the main gear wheel is mounted on a short hollow shaft, carried

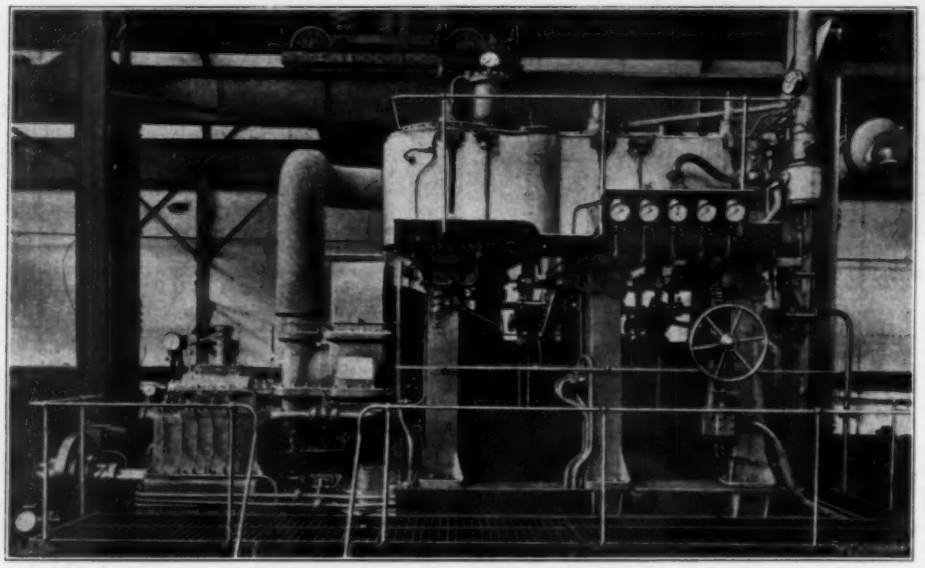


FIG. 6—BAUER-WACH TURBINE-RECIPROCATING ENGINE

in its own bearings, which is coupled to the engine fly-wheel. The pinion shaft is connected to the Vulcan hydraulic-mechanical coupling, part of which carries the gear wheel, which meshes with the pinion on the low-pressure turbine shaft. Suitable connections are made to engine cylinders and to the ship's condenser. The unit is so built that by a small alteration either the engine or the turbine may, in case of an emergency, be employed as the propelling unit. Different arrangements can be used according to whether it is desired to reverse by engine or turbine. At the end of December the Tecklenborg works had new installations for two fishing vessels and seven cargo ships on order, while four other cargo ships and the engines of three passenger cargo vessels are to be converted and low-pressure turbines fitted, according to the Bauer-Wach system.

Conclusion.

Towards the end of the year several important shipbuilding orders were placed, which, together with work carried over from the months before the coal dispute, auger well for increased prosperity in the shipyards during the coming year. There is hope that agreement will be reached with regard to better time-keeping in shipyards and repairing shops, which should also tend towards increased output and better ability to meet foreign competition. Above all, we look forward to the successful completion of new ships embodying the technical advances referred to in this article.

ACCORDING to the *Yorkshire Post* the coal stoppage has interfered seriously with the work of extension at the Billingham Works of Synthetic Ammonia and Nitrates, Ltd., but considerable progress has, nevertheless, been accomplished. Instead of reaching maximum production in June, as originally intended, the new plant will probably not be ready until the end of 1927, when a daily output of 215 tons of ammonia is expected. Plans are under consideration for the construction of a new dock to facilitate the export trade.

Water Supply in 1926.

No. I.

General.

Although it was much interfered with by the stoppage of coal supplies, a considerable amount of work in connection with water supplies was carried out in various parts of the country during the year. Indeed, so much was in hand that it would be quite impossible in the space at our disposal even to give a list of those places which are engaged in increasing their supplies or are contemplating doing so. Several places also completed works during the year. Some instances are dealt with separately below, and, in addition to numerous others of greater or less magnitude, we may say that among those which have works in hand or in contemplation to the value of £40,000 or over may be mentioned Axbridge, Ayr, Barnoldswick, Barnsley, Birmingham, Bradford, Bury and District Joint Water Board, Doncaster, Douglas, Edinburgh, Guildford, Halifax, Hinckley, Paignton, Preston, Spalding, Swindon, the Tees Valley Water Board, West Ward (Westmoreland), Wigton, and Wolverhampton. Works of greater or less importance are also in progress or contemplation in the Amman Valley, Balrothery, Bath, Chard, Cheddleton, Clay Cross, Colchester, Dublin, Guildford, Huddersfield, Kirkcudbright, Leeds, Llangollen, Longford, Maesham, Skegness, Tiverton, and Uttoxeter.

No new development of outstanding importance took place during the year, but a decided increase in the use of chlorine in one form or another for sterilisation and of mechanical filters was noticeable throughout the year. The plant at Walton, to which we refer below, is an interesting example of the latter.

Quite one of the leading features of the year, and certainly one of the most pleasing, was the delightful history of the New River from the pen of Sir A. C. Houston, which was published in the annual report of the Metropolitan Water Board.

Trouble due to unsound rock has, we understand, led to the temporary stoppage of work on the foundations of the core wall for the dam which Belfast was constructing in the Silent Valley. The difficulty was, we gather, due to the fact that solid rock was found to lie at a much greater depth than had been originally anticipated. The matter is to be considered by a consultatory board of engineers.

Walton-on-Thames Filtration Plant.

On July 19th Mr. Neville Chamberlain, the Minister of Health, formally opened for service a new filtration and pumping installation which the Metropolitan Water Board has constructed at Walton-on-Thames. The plant is noteworthy in several respects. To begin with, it is capable, if called upon to do so, of dealing with a volume of 35 million gallons per day, or enough to satisfy the full needs of such a city as Birmingham or Melbourne, each of which has a population of about a million inhabitants. Yet, as showing the vast area under the Board's jurisdiction, 35 million gallons only represent between one-seventh and one-eighth of the total daily volume of water supplied. Then, again, a salient feature of the plant is that there is a combination of mechanical and slow sand filtration. In a building covering an area of only some five-eighths of an acre there are housed eighteen primary open gravity filters, each designed to be capable of passing from one to two million gallons of water per twenty-four hours at rates between 100 and 200 gallons per square foot per hour. The filtrate from them is passed to a battery of six slow sand filters, each with an area of five-sixths of an acre, or a total area of 6 acres of beds. As the result of combining primary and secondary filtration, it is anticipated that it will be possible to increase the rate of filtration through the secondary beds to between three and our times the normal rate when slow filters alone are used. As an additional precaution, arrangements have been made for the filtrate coming from the secondary filters to be chlorinated. The plant is completed by two pumping engines of widely differing types, one being a vertical triple-expansion steam pumping engine of the ram type, and the other a duplex high-speed motor-driven centrifugal pump. The new plant has been incorporated with the previously existing pumping station, and the combined installation, taken in conjunction with the neighbouring reservoirs and filter beds, forms one of the most interesting waterworks in the metropolitan area. A view showing the primary filter house and the secondary filters is given in one of our Supplements to-day.

Aberdeen.

On September 30th the new supply works which have been carried out by Aberdeen were formally opened by H.R.H. Princess Arthur of Connaught. The works, which were begun in the autumn of 1920, include (1) an intake on the river Dee and a screening chamber; (2) an intake conduit with a capacity of 20 million gallons per day; (3) a 24 million gallon storage reservoir at Invercannie—see Supplement; (4) slow sand filters with areas of 0·4, 0·4 and 0·6 acres respectively; (5) an aqueduct 17½ miles long, with an initial capacity of 11 million gallons per day and an ultimate capacity of 14 millions gallons per day; (6) a pumping station, with a total pumping capacity of 11·3 million gallons per day; and (7) a 7 million gallon service reservoir. The aqueduct consists of 0·7 mile of concrete cut and cover, 5ft. 3in. by 3ft. 8in., followed by 2 miles of 46·2in. cement-lined steel pipes, 9·6 miles of 38in. cement-lined steel pipes, 3 miles of 46·5in. cement-lined cast iron pipes, 0·5 mile of 46·2in. cement-lined steel pipes, 1 mile of 44·2in. cement-lined steel pipes, and 0·6 mile of 48in. concrete conduit. An old steam pumping plant, which had been in operation for forty years, was scrapped, and its place taken by a new engine house, containing centrifugal pumps driven by electric motors. Two of the pumps will each deliver 2·2 million gallons per day to the Slopefield reservoir, the top water level of which is 308ft. O.D., two will each deliver 3·2 million gallons a day to the new service reservoir—Airy Hall—T.W.L. 242ft. O.D., and two will each deliver 0·25 million gallons per day to the Pitfodels reservoir, T.W.L. 402 O.D. The current is obtained from the Corporation's electricity undertaking at 6600 volts, and is transformed down to 400 volts. The estimated cost of the full scheme is £1,125,000, and the cost of the first instalment was a little over £1,000,000.

Liverpool—Vyrnwy Supply.

Aber Tunnel.—During the year 1926 the inlet heading of the Aber Tunnel was advanced 864ft., making a total length driven to date of 2928ft., or 29 per cent. of the whole. The rock passed through was appreciably harder than that met in the first portion of the heading, but beyond that no special difficulties were encountered, and the quantity of water to be dealt with was small.

Vyrnwy Aqueduct.—At the beginning of the year the Water Committee of the Corporation decided to commence work in connection with the third instalment of the aqueduct from Vyrnwy, as it was evident that the demands for water had overtaken the present resources of the undertaking, and that it was necessary to introduce additional supplies from the reserve which the Corporation still has in hand at Lake Vyrnwy. The aqueduct is divided into a number of sections, of which the upper section, lying between Vyrnwy and Oswestry, carries unfiltered water. That section has a total length of 13 miles of a double line of 42in. pipes, the carrying capacity of which is less than that of the sections below Oswestry. It was decided for the present to lay 4½ miles of the third instalment, divided into two sections, one on each side of the balancing reservoir, about midway between the lake and Oswestry. These sections will be cross connected to the two existing mains at each end of the new lengths, and it is calculated that by that means the delivery to Oswestry will be increased by 4 million gallons per day. The pipes, which are being supplied by the South Durham Steel and Iron Company, are of steel, 42in. internal diameter and $\frac{7}{16}$in. thick. The ordinary pipes are 25ft. in length, with sockets for lead joints. The pipes are protected internally by bitumen, $\frac{1}{8}$in. thick, applied centrifugally, while the outside has a double wrapping of hessian, thoroughly impregnated with hot bitumen. Special means have been adopted by which the internal lining is made continuous throughout the whole length of the main. In spite of the coal dispute, the pipe manufacturers were able to commence deliveries at the beginning of September, and pipes are being sent forward in sufficient quantities to enable substantial progress to be made. The pipe-laying contractors are Sir William Prescott and Sons, Ltd., of London, and at the beginning of December a length of about 1 mile had been laid.

Electrical Engineering in 1926.

No. I.

BACKWARD as this country is supposed to be in all branches of electrical engineering, there is never any difficulty in collecting sufficient information to fill the columns allotted to this annual article. Regardless of industrial troubles and shortage of general engineering work, British electrical manufacturers manage to go on securing orders for electrical plant. Although the home demand for electrical products during the period under review no doubt left much to be desired, consideration of the important contracts placed in this country for steam and hydro-electric generating installations, apparatus for electrical distribution and equipment for industrial purposes and traction throughout the world shows clearly that in all branches of the industry Great Britain is competing successfully in the world's markets. Under the conditions prevailing in 1926 electrical progress was as good as could be expected; indeed, if all the adverse circumstances are taken into account, progress in electrical engineering in this country has for some years past been much more satisfactory than some seem to believe. With the revival of trade there will undoubtedly be a big jump in the demand for electricity. For domestic purposes the call for current is said to be increasing at an unprecedented rate. Electricity is, moreover, constantly being put to new uses, one of its latest applications being that of heating the London Zoo. Sooner or later the electrical manufacturers will undoubtedly experience a very material increase in the volume of the home business, which at the moment is not as good as it should be. No doubt when that increase comes, some will attribute it to the Electricity (Supply) Act, but, in the opinion of many, progress would be just as rapid and possibly more rapid without the Government's aid. In the past, legislation has done far more to retard electrical progress than to advance it. Government control of other public services, such as the telephone service, has not benefited the public, and it will be strange if restrictive legislation proves any more beneficial in the case of the supply of electricity. The electricity supply business was progressing pretty well before the new Bill was introduced, for figures for 1925 show that the sales of electricity by authorised undertakers increased by upwards of 50 per cent. since 1922. That the public will obtain electricity any cheaper than it would under ordinary circumstances we do not believe, nor do we consider that the scheme is going to be of very much assistance in the way of bringing cheap electricity within the reach of the agriculturist.

Beyond putting the fact on record, however, that during 1926 the Electricity (Supply) Act was passed, we do not propose to consider the matter. The object of this article is, of course, to review electrical progress, particularly technical progress, which, after all, is of the greatest interest to engineers. Hitherto it has been our practice to deal at length with the principal work carried out by electrical firms, to record the opening of new power stations and extensions to existing stations, but it has long been apparent that sooner or later this practice would have to be modified. So much work is now undertaken during a period of twelve months, and so many changes are made on the supply side of the electrical industry, that it is no longer possible to deal individually with electrical contracts, extensions to power stations, and so forth. Besides the fact that it is now a physical impossibility to get all the material of this nature into a few columns of THE ENGINEER, much information concerning the opening of new power stations and extensions to existing stations is to be found in the Electricity Commissioners' reports. The remainder of this article will be devoted more particularly to those developments of outstanding interest, and especially to things that constitute more or less a departure from previously existing practice.

Research.

Following upon the stimulus given by the favourable report of the Committee of investigation which examined the work of the British Electrical and Allied Industries Association during the first five years of its existence, the year that has just closed proved to be one of great interest. The researches made by the Association on insulating materials have resulted in the preparation of a number of proposals for standard purchasing specifications in a field in which this class of work is urgently required. Investigations into the nature of the breakdown of insulation and methods of measurement of the properties which are essential in good insulation now show great promise, substantial contributions to knowledge and technique having been made. At the recent conference of the International Electrotechnical Commission at New York, at which the British Electrical and Allied Research Association was represented, a valuable report on the use of sphere gaps for the measurement of high voltages was presented, and Dr. Michie, one of the Association's representatives, was appointed to supervise research work on sludge in transformer oils now being carried out in this and other countries. The researches on electric circuit breakers have yielded a number of reports, which establish new facts of great importance, the industrial applications of which have been made the subject of further applications for patents. One series of experiments shows a remarkable reduction in the energy released and the corresponding stresses on opening heavy circuits by the use of devices incorporating features of design based on discoveries made to date. Investigations carried out at the Carville power station of the Newcastle Electric Supply Company have resulted in new and important observations. The large variations observed in the results of consecutive tests under apparently similar conditions have baffled investigators elsewhere, and notwithstanding the important analyses carried out by the Association in the first five years of its existence, large unexplained sources of variation still remained. To a great extent, however, these have been unravelled by the work of the past year, and it is believed that their origins are now traced to such an extent that certain detailed investigations now proceeding should furnish data affording a substantially complete explanation of the many baffling results obtained in the early stages.

In the General Electrical Company's research laboratories at Wembley an automatic machine was constructed for the voltage rating of electric lamps by colour matching, with two photo-electric cells of different sensitivities. In routine photometry work the machine eliminates the human eye factor, and is said to enable an observer to rate 200 vacuum lamps per hour with a mean error of 0·13 volt. Improvements were made in gas-filled photo-electric cells. Greater stability and sensitivity of these cells have been obtained, and the fact has been established that photo-electric cells must be designed for their own particular purpose. Considerable advances were made in the application of X-ray spectroscopy to a wide variety of problems, and X-rays have become a tool of every-day use. As regards the employment of X-ray methods in metallurgy the mechanism of preferred orientation of crystal fragments during the working of metals has been studied in the case of tungsten by the examination of ingots in various stages of swaging. The constitutional changes occuring in clays on heating were also investigated, and it was shown that mullite and not silmanite is formed in clay at 1000 deg. Fah. Failures in refractories are now regularly diagnosed by X-ray methods. As regards the application of X-ray methods to glass, flouride opals have been studied, and it has been established that the particles causing the opacity are calcium flouride or sodium or a mixture of the two, this conclusion being contrary to all previous theories. Faults in glass bulbs and tubing arising from other causes are now regularly diagnosed in the first instance by X-ray methods.

The advances made by the General Electric Company in the thermionic valve department were mainly in the direction of increased size. Oscillating valves with water-cooled anodes are now made in sizes up to 15 kilowatts input, and modulators up to 10 kilowatts, dead loss. A rectifying valve has been made that works up to a pressure of 25,000 volts, with a maximum plate current of 8 ampères. The capacity of dull emitting valves has been increased from 75 to 450 watts, and indirectly heated cathode receiving valves were developed for working off alternating-current mains.

Hydro-electric Plant.

The fact that this country possesses little water power has not caused British electrical manufacturers to ignore the hydro-electric side of the electrical business or to overlook the fact that in other countries there is a considerable demand for water power plants. At least two English firms, namely, the English Electric Company and the Metropolitan-Vickers Electrical, appear to be securing a fair number of orders of this description, but limitations of space will not permit us to deal in detail with the hydro-electric work which these and other firms, such as Bruce Peebles and Co., Ltd., have carried out during the past twelve months. The English Electric Company built some large water turbines and alternators for use in various parts of the world, whilst the Metropolitan-Vickers and Electrical Company and Bruce Peebles and Co., Ltd., turned out water-wheel alternators.

Converters.

Although Sir John Snell and others have emphasised the fact that rotary converter sub-stations are much more costly to construct and operate than the static transformer sub-stations associated with alternating-current distribution, the demand for rotary converters and similar machines, such as motor converters, does not appear to diminish. The size of converters has increased appreciably during recent years; there is, moreover, now a decided tendency to operate sub-stations containing rotary converters and similar machines automatically. For one of the large London supply companies the British Thomson-Houston Company built four 2500-kilowatt motor converters. A large proportion of the B.T.H. converting plant destined for Australia and New Zealand where labour costs are high, is to be operated automatically. Converting plant figures prominently in the output of the General Electric Company, which supplied, among other machines, eleven 2000-kilowatt rotary converters operated on the remote supervisory control system to the South African railways. Some large machines, viz., 3000 and 2000-kilowatt rotaries, were built by the Metropolitan-Vickers Electrical Company for Buenos Aires. Particulars have been sent to us by this firm of a considerable amount of automatic control work carried out in connection with automatic sub-stations, but we cannot do more than mention that one of the latest automatic installations is at the Soho-square sub-station—illustrated in one of our Supplements to-day and described in THE ENGINEER of October 15th of last year. Requirements which are rather unusual had to be met by the English Electric Company, in carrying out the contract for automatically-controlled converting plant for a Japanese railway company. In one of the sub-stations there are three 750-kilowatt 750-volt converters, any two of which had to be made capable of operating in series to provide 1500 volts for the line, whilst the third machine serves as a spare. The first firm to take up the manufacture of motor converters in this country, viz., Bruce Peebles and Co., Ltd., is still turning out these machines in very fair quantities, and for considerably larger outputs than in the past, a machine of 2000, for instance, having been put in hand for the Johannesburg Municipality. The firm is also supplying two 500-kilowatt automatically-controlled motor converters for the Capetown Municipality—the first full automatic motor converter installation in South Africa. Notwithstanding the proposal to standardise frequency in this country, this company recently constructed two 3000-kilo-

FIG. 1—PHOTO-RADIOGRAM TRANSMITTER

watt frequency changers for the Govan Power Station of the Glasgow Corporation.

Wireless Communication.

The establishment of wireless services embracing the whole of the Empire was one of the principal electrical engineering events of 1926. The Imperial wireless system thus provided consists of a station at Hillmorton, near Rugby, with the highest power of any wireless station so far built, and a number of Marconi short-wave beam stations in different parts of the country, carrying out commercial wireless services with each of the principal Dominions and India. The Rugby station was opened on January 1st, having been in the course of erection since September, 1923. There are two aerials supported on twelve masts, one for telegraphic transmission on a wave length of 18,740 m., whilst the other serves for duplex telephony experiments with New York. The station is used for British Foreign Office official news, which is transmitted three times daily to the world at large, and also for telegrams and Press messages to ships in all parts of the world. The beam stations which, so far as the Empire is concerned, are being built by Marconi's Wireless Telegraph Company on behalf of the General Post Office, are designed to concentrate their radiated energy in one direction so that each station only communicates with one other station, its power outside a certain angle being so limited that it will not in the ordinary way be received by other stations. The stations have been built in two groups. The transmitting stations for communication with Canada and South Africa are at Bodmin, in Cornwall,

FIG. 2—PHOTO-RADIOGRAM RECEIVER

whilst the receiving stations for these countries are at Bridgwater, in Somerset. A view of the machinery hall at Bodmin is given in our Supplement. Transmitting stations for communication with India and Australia are situated near Grimsby, in Lincolnshire, and the receiving stations for these countries are near Skegness. The first of these services was opened at midnight on October 24th for communication with Canada. The advantages of the Marconi short-wave beam system have often been described, but it does not supersede the all-round transmission system in cases where stations are required to conduct traffic with a number of points in different directions. Besides the wireless stations built for the Government, the Marconi Company made good progress with the building of beam stations to be operated by itself for communication with the United States of America and South America. The company has also nearly completed the beam stations at Lisburn and those in the Portuguese colonies of Angola and Mozambique. Still another important wireless development was the establishment of a commercial service for the transmission of pictures by wireless across the Atlantic between London and New York. The quality of the pictures sent across the Atlantic, in accordance with Captain R. H. Ranger's system, varies with the suitability of the original photograph, and whilst many good half-tone pictures have been received, at present the system appears to be most suitable for the transmission of line drawings. Pictures in the form of pen and ink drawings have been sent between London and New York in considerable numbers, and the reproductions have left little to be desired. Whilst work remains to be done in the direction of perfecting the system so as to make it capable of transmitting half-tone pictures satisfactorily, there is every indication that before long the difficulties met with in this connection will be completely overcome. An illustration of the transmitter at the Marconi Central Telegraph Office, Radio House, London, is given in Fig. 1, whilst Fig. 2 shows the photogram receiver, which can make two pictures at the same time. The main broadcasting achievement was the bringing into operation of the international agreement so far as Europe is concerned for the re-allocation of wave lengths so as to prevent European broadcasting stations interfering with one another.

Transatlantic Wireless Telephony.

Ever since 1923 experiments have been proceeding to determine the conditions that have to be met by a wireless Transatlantic telephone service, systematic observations having been made on the strength and quality of signals and the quantity of atmospheric disturbance at different periods of the day throughout the year. Analysis of the data obtained led to the construction of a 200-kilowatt telephone transmitter at the Post Office wireless station at Rugby, in order to carry out tests on two-way communication with America, and, as reported in our issue of March 12th, on Sunday, March 12th, we had an opportunity of carrying on a two minutes' conversation with one of the engineers at the headquarters of the American Telegraph and Telephone Company, of 24, Walker-street, New York City. The transmitter, part of which is illustrated in our Supplement, utilises part of the mast and antenna system erected at the station and also part of the power plant and other internal gear provided by the Post Office for the telegraph set. The telephony modulation and valve amplifier plant was installed by the Western Electric Company, now Standard Telephones and Cables, Ltd. The lines from London carry the telephone speech to the modulation panel at Rugby, where the carrier frequency is modulated at low power, and use is made of the so-called single-side band system, the advantages of which are now well known. Speech from America is received at Wroughton, near Swindon, on a receiving set—see Supplement—installed by the Post Office in conjunction with a double-wave antenna, each arm of which is three miles long. The receiver is connected by underground loaded cable circuits to the London Trunk Exchange. The circuits to the transmitter and those from the receiver are brought together at the London Trunk Exchange in apparatus of a special character. In order to reduce the width of the band of wave lengths required it was decided to adopt the same wireless frequency for transmission and reception, and the frequency in use at the moment is 60 kilocycles per second. When the London subscriber speaks, his voice currents operate switches so that the transmission path to America is put through and the reception path is temporarily blocked. When he ceases speaking, the switches block the transmission path to Rugby, and at the same time restore the reception path from Wroughton so that the American subscriber can speak to England, and this procedure takes place automatically whilst two-way conversation is being carried on over the circuit. Two-way conversation with America first took place on February 7th, 1926, and the demonstration to which we have alluded about a month later. Since that date the experiments have been directed towards the achievement of two-way working on one wave length, and the improvement of the voice-operated switching arrangements. It is generally agreed that the quality of the service is equal to that attained in ordinary trunk line conversation, and, except for periods of bad atmospheric disturbance, the quality is maintained fairly well throughout the day. Experiments are still being carried out with a view to improving the system as regards resisting disturbance from atmospherics.

It was officially announced on Wednesday last that the Post Office hoped to start the service with a preliminary public test beginning at 1.45 p.m. to-day.

Television.

Prior to the year under review, television, which is the instantaneous transmission of a living scene and not the mere transmission of photographs, remained an unsolved problem. The lack of a light sensitive device capable of responding at the immense speed necessary was for many years the obstacle to success. But during 1926 Mr. J. L. Baird gave for the first time a demonstration of practical television, and a brief description of his method appeared in THE ENGINEER of June 18th. Since that time rapid progress is said to have been made in the direction of improving the apparatus. In the early experiments it was necessary to use very intense illumination at the transmitting end, with the result that persons being transmitted were subjected to considerable discomfort. The necessity for this intense illumination was, it is said, the chief obstacle to commercial success, for although actors and other public people are believed to love the limelight, it is certain that few of them would have been prepared to face the intense concentrated rays which were originally used. The difficulty has now been overcome, however, by using the infra red rays, which have no deleterious action on the human body, and which transcend in penetrative power the rays of the visible spectrum. The use of these rays in conjunction with Mr. Baird's televisor enables transmissions to be carried out without any discomfort to the sitter, who now sits in a totally dark room, the reproduction at the receiving end being in no way affected. The first wireless television licence was granted during the year to the company which has taken over Mr. Baird's televisor, and regular experimental transmissions are now being made on a wave length of 200 m. between the company's headquarters in Upper St. Martin's-lane and the company's laboratory at

FIG. 3—THE BAIRD TELEVISOR

Harrow. Every effort is being made to simplify and improve the reproduction of the present apparatus, with a view to placing a televisor on the market, and one of the latest receivers on which experiments are being made is shown in Fig. 3.

Electricity in Agriculture.

According to Mr. R. Borlase Matthews, electro-farming made substantial progress during the year under review. About 650 British farmers are now utilising electricity as compared with 200 a couple of years ago. Expectations aroused by the Electricity Bill have, however, had a retarding effect on the purchase of private generating installations, the tendency now being to hang back, pending the promised general supply of cheap electricity. Experience denotes, Mr. Matthews informs us, that farmers are eager to use electricity in the dairy, in barns, for pumping, chaffing, root cutting, threshing, corn cutting, &c., and on the poultry farm for lighting and incubation. The Fife Electric Power Company is supplying thirty towns and villages and about fifty farmers. The Taunton Corporation electricity department supplies fifty-seven farms situated within its area. The Yorkshire Electric Power Company supplies about fifteen farms; whilst some fifty-five farms have been connected to the mains of the Ayrshire Electricity Board. In the borough of Aylesbury considerable progress has been made with the development of rural lines. The city of Birmingham is arranging for the provision of 25 miles of such lines; whilst the Wolverhampton Joint Electricity Board is contemplating erecting 45 miles of rural lines. At Chester six of the ninety farms connected to the supply system have been selected for a proposed intensive experimental study, and for the collection of data. Good progress has been made in the area of the South Wales Electrical Distribution Company, where nearly fifty farms have been connected. Many of these farms are of under 50 acres. On the research side the chief advance made in this country during the year was in the application of ultra-violet rays to poultry and stock. Experience is said to have proved that the milk yield in cows and goats has been increased by the application of this process, which also accelerates the growth and egg production of hens. Upon these experiments the attention of manufacturers is being focussed, for up to the present expensive medical apparatus has been used, and there is a wide field for manufacturers who can produce something cheaper. The new Milk Regulations, which come into force next April, call for better dairy refrigeration and general equipment, with the result that manufacturers of electrically operated milking machines, churns, &c., have already found a better demand for their goods.

THE LARGEST PASSENGER LOCOMOTIVE.—Our readers will have noticed that, by an obvious inadvertence, the adhesive weight of the Baltimore and Ohio Railway locomotive, which was described in our issue of December 24th last, was, in the table of general particulars, added to the weights of the engine and tender to give the total weight. The total weight of the engine and tender was correctly given in the text, namely, 659,000 lb.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Situation.

THE first week of the year 1927 has certainly witnessed a revival in industrialists hopes for a year of genuine and progressive prosperity. On 'Change in Birmingham to-day—Thursday—Midland iron and steel masters and engineers pointed to signs of renewed and increased activity in most Midland industries, and held that the arrears of orders which have been held up since the spring are likely to lead to a period of activity which should be followed by a general prosperity based upon the gradually improving economic conditions in Europe. Every one is anxious to get busy, and the number of inquiries in circulation for iron and steel materials were far in advance of anything of recent date. Orders placed, too, were for slightly larger tonnages, but forward contracting is still held up by the uncertainty of prices. It is generally recognised that prices must come down now that the emergency has passed, and consumers and merchants are not likely to do anything to retard it. For the time being therefore most of the orders placed are for quick delivery.

Steel.

Supplies of steel are now beginning to come forward freely, but business is not as brisk as it might be owing to the unsettled condition of prices. Quotations vary considerably, and users want some assurance that they will not be able to buy to better advantage in a month's time. Next week's quarterly meeting in Birmingham should do something towards stabilising steel quotations, and with that in view many steel consumers on 'Change to-day held up their orders till quarter-day. The figure commonly named for angles is £8. Business can be done at half-a-crown less, however, while some firms want appreciably more. Small steel bars are variously quoted between £8 15s. and £9. For gas strip £9 is asked, whilst Staffordshire hoops are £11 10s., with business flat. Though continental steel quotations are somewhat easier there is little business being placed. Billets for February–March delivery are quoted £6 2s. 6d.; bars, £6 10s.; and plates, £7 10s.

Raw Iron.

Progress is still being made in this area towards a return to normal conditions at the blast-furnaces. Two additional furnaces are being re-lighted in Derbyshire and two in Northamptonshire for the production of foundry pig, while preparations are in hand for putting others into commission. As previously reported, three of the Spring Vale furnaces will be producing basic directly, and it is understood that the affiliated mills are to be got into operation forthwith. There is already more pig iron on offer, and reports from the Black Country, Northamptonshire, Derbyshire, and North Staffordshire are to the effect that furnace owners are hopeful that they may be able to give small tonnage deliveries before the end of January. Most of the present pig production is being absorbed at allied steel works, so that there is likely to be some scarcity of pig iron for some weeks to come. Moreover orders accumulated during the strike, and some iron makers are not anxious for fresh commitments until some progress has been made in clearing off the old. On 'Change in Birmingham to-day Derbyshire No. 3 foundry pig was quoted £4 12s. 6d. for January and £4 5s. for February at furnaces. For Northamptonshire £4 2s. 6d. was asked. But it was possible to get orders accepted at half-a-crown below that figure. Continental pig iron is still being handled by Birmingham merchants, the price this week being easier at £5 7s. 6d.

Manufactured Iron.

Staffordshire finished iron is in fairly brisk demand at about late prices, the smallness of the output accentuating the shortage in high-grade bars. Prices are considered to be high, and little disposition is yet shown by users to buy forward. Lancashire Crown bars can be bought at £12 10s. if the orders are sufficiently attractive. Staffordshire mills generally quote £12 15s. to £13. Nut and bolt bars remain at £11 5s. Belgian No. 3 iron bars, lately quoted at £6 15s., can now be had at £6 10s. This iron is being increasingly used by Black Country makers of nuts and bolts.

Galvanised Sheets.

In the galvanised sheet trade business is quiet. Corrugated sheets of 24-gauge remain at £16 5s. Most mills have enough work on their books to carry on through January, and some good inquiries from abroad are being received, including one for 250 tons from India.

Rolling Stock Outlook.

The rolling stock works of the Midlands consider the outlook for 1927 very rosy. They are already well placed for business, and have heavy arrears of orders to dispose of. Carriage and wagon building has been held up for want of iron and steel supplies, and as the latter are now forthcoming from the local mills, full activity at the works is promised for many months to come. The steel works on their part are anxious to increase output, and are giving preference to builders who can accept large tonnages. A great deal of foreign work in the way of carriages is done at Birmingham workshops, and orders in hand include contracts for the Far East, India, South America and South Africa, while the Western Railway at Buenos Aires has placed contracts for a particularly large type of coach. The Birmingham Railway Carriage and Wagon Company, Ltd., of Smethwick, has just secured an order for 100 wagons for the Rhodesian railways, the approximate value being £40,000. Great complaints as to shortage of trucks were made following the settlement of the coal dispute, and orders for new trucks have been placed by some large collieries, including a contract for 250 wagons. The railways are also expected to be good customers in this direction.

Black Country Prospects.

There is a great improvement in the industrial position in the Black Country. Nut and bolt manufacturers have received large orders for railway and shipping work, which, in some cases, will keep their establishments in full swing for the year, and in others have necessitated extension of the premises. Tube and chain and anchor makers are also looking forward to a busy year, as orders are coming in at a good rate. Black Country works producing smaller sizes of steel for miscellaneous requirements are finding a useful outlet in the demands from the stamping trade and the motor building department. Many of the smaller industries have been at a standstill for months owing to shortage of materials, but activities are now being generally resumed and contracts for supplies are being placed.

Owners' £10,000 Grant to Miners.

At a conference of the new Notts Miners' Industrial Union, Mr. H. E. Mitton, representing the owners, said they would grant £10,000 towards the old-age pensions scheme, with an immediate payment of £2500. Subsequent payments were conditional upon the soundness of the scheme, the adequate representation of the owners, and the response of the miners.

Black Country Waterways.

Midland and Black Country manufacturers and engineers view with considerable concern the possibility of the closing of the Birmingham and Worcester canal system, which is threatened through the inability of the Sheerness section to carry on its part of the system profitably. The Sheerness section some time ago made an appeal for assistance to Midland traders, and it is felt that the position is becoming critical. A deputation from the National Council of Inland Waterways has met the Transport Committee of the Birmingham Chamber of Commerce which has taken the matter to a special Canals Committee of the Birmingham Council. The question of a ship canal is, as is well known, closely associated with the retention of those old-fashioned waterways, and many consultations have taken place between the Midland municipalities interested in the matter on the initiative of the Birmingham Corporation. The question has been complicated somewhat by the necessity to choose between a ship canal to the Severn and an alternative waterway to the Mersey. Birmingham is greatly interested in the use of these canals, and whatever happens regarding the proposed ship canal it is felt that the existence of the present waterways must not be imperilled. However, the position of the Sheerness section is likely to force matters to a crisis, making it imperative either to go forward with a bigger scheme, or to make something more of the present system. The existing canals may be out of date, but to scrap them would be a great blow to Midland and Black Country industries. An instance of their service to Staffordshire ironmasters was given in this letter a few weeks ago. So far as the larger question of a ship canal for the Midlands to the sea is concerned, it looks as if a choice will have soon to be made between the northern and southern schemes. The latter has the recommendation that the work is already done as far as Gloucester, but for the Black Country an outlet northwards through Cheshire would have its advantages. There is little doubt that a direct outlet to the sea would be a very big advantage to Midland industries.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

A Threatened Salford Migration.

IN Salford, which is only separated from Manchester by the river Irwell and is itself a large engineering centre, industrial concerns are becoming very restive under the yoke of the high rates which association with the city entails. One engineering firm, the Harland Engineering Company, Ltd., which has a works in Salford, has made a strong protest in the course of a letter to the Mayor, and threatens, unless something is done to curtail "the vicious advance" in rates, to withdraw its works altogether from the city. The firm pointed out that the Salford rates, which it pays, represent 18·2 per cent. of its productive wages bill, whereas in its Scottish factory they represent only 3·31 per cent. Salford rates have increased from 8s. 6d. in the pound in 1913 to 16s. 11d. in 1926–27, or an advance of 99 per cent., and, where the increased assessment is in force, an increase of 189·7 per cent. The firm went on to say that having regard to the trade position its capacity to pay is immensely less at the present time than it was in 1913. Other industrial concerns in the city are taking up an equally strong attitude.

Financial Results.

The financial reports of two local engineering companies make interesting reading at the present time. In the case of Edward Wood and Co., Ltd., Ocean Ironworks, Salford, constructional engineers and contractors, the directors announce that, in view of the dislocation of trade caused by the coal dispute, they have decided not to declare an interim dividend on the ordinary shares for the half year ended November 30th, considering it desirable to conserve the company's financial resources. For the last financial year the company resumed dividends on the ordinary with a payment of 2½ per cent., no distribution having been made in the two previous years. In the last annual report it was stated that the position shown in the order books was exceptionally favourable, and surpassed the value of work in hand at any period since the war years. From the announcement made by Beyer, Peacock and Co., Ltd., locomotive engineers, Gorton, Manchester, that it is intended to pay a full year's dividend on the 5½ per cent. cumulative preference shares to the end of 1926, an improvement in the position of the company would appear to have been effected, and the prospects for the ordinary shareholders, who have received no dividends since 1922, seem to be brighter. In view of the difficulties which locomotive builders experienced during the coal strike in securing supplies of steel, the result may be regarded as satisfactory.

Local Contracts.

Two important contracts have been announced this week. In connection with the Lister Drive power station of the Liverpool Corporation, the Tramways Committee recommends that the contract for the 25,000-kilowatt turbo-alternator and condensing plant, of a total value of £110,575, be placed with the Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester. Expenditure estimated at over a quarter of a million pounds is involved in the order which Cammell, Laird and Co., Ltd., Birkenhead, has secured for a complete set of main and auxiliary machinery for the cruiser to be built at Portsmouth Dockyard, work which will provide steady employment over a long period for a large number of men.

Launch of the Arandora.

The Arandora, the fifth of the Blue Star Line's new vessels, was successfully launched from the Birkenhead yard of Cammell Laird and Co., Ltd., on Tuesday, Lady Edmund Vestey, wife of Sir Edmund Vestey, joint head of the line, performing the naming ceremony. The new vessel will help to maintain a fast fortnightly service between London and South America.

Royal Cars for Australia.

Six six-cylinder Crossley limousine cars, the first half of a fleet of twelve cars designed for the use of the Duke and Duchess of York on their Australian tour, left Manchester on Saturday, January 1st, by the Federal Line steamer Nowahera for Sydney. Among the many interesting features in the car specially designed for the personal use of their Royal Highnesses are red side lights to enable the Royal car to be distinguished at night.

Second Largest Platform.

The construction of the new platform connecting Victoria and Exchange stations, Manchester, is well under way, and but for the interference with the progress of the work as a result of the coal stoppage would by this time be approaching completion. When finished the platform will be 2175ft. long, and, it is claimed, will rank as the second largest in the world. Part of it spans the river Irwell between the two stations, a distance of 140ft.

Non-ferrous Metals.

The home demand for tin during the past week has been of limited extent, but fair purchases by American interests rendered a service to the market by helping to resist the effect of fairly substantial offerings of near metal early on, with the result that prices at the time of writing show little or no difference on balance compared with a week ago, the slight loss in values which was recorded at the close of the market last week end having been recovered since. The statistical position at the moment is not regarded without favour by the "bulls," stocks in this country being estimated at no more than 1250 tons. Cash tin at the moment is about £301 per ton, which represents an advance of more than £10 compared with the corresponding date of last year. Although in the case of copper there are expectations of a largely increased demand for the metal in the United States before very long, American buying at the moment is quiet, as it is also in this country and on the Continent. Prices have further weakened since last week, and are now lower than they have been for many years. Lead is pretty well where it was a week ago, in spite of a continued quiet demand. Spelter also is only moving off in moderate quantities, but quotations keep reasonably steady, and there is little change on balance.

Iron.

There has been more interest in the iron market on 'Change here since the re-opening after the holidays, although it has been more in connection with the news that further important additions to productive capacity had been brought into operation with the turn of the year, and with the prospects of getting deliveries against existing contracts rather than in the placing of new business by consumers. At the present rate of increased production, supplies of pig iron should be available in fairly substantial quantities before the end of this month, and buyers are looking for a lower level of prices. This undoubtedly is a factor which is tending to reduce current bookings. Certainly there is no evidence that buyers are venturing any further ahead than is necessary to ensure early supplies. With the several additional blast-furnaces that have been started in the Derbyshire area within the past few days there are yet apparently limited quantities that can still be bought for delivery this month, and quotations keep steady at the equivalent of 100s. per ton, delivered Manchester, roughly 7s. 6d. per ton less than this being asked in connection with February business. Middlesbrough, at about 100s. per ton delivered, West Coast hematite at 97s. 6d., and Scottish at 110s. to 112s. 6d., are also being offered here for early delivery. The demand for Lancashire bar iron is still rather subdued, but prices show no change at £12 10s. for Crown quality and £11 5s. for seconds.

Steel.

In respect of steel also productive operations are on a steadily widening scale, although, so far, available supplies are extremely limited. By about the middle of the month, however, a decided improvement should be witnessed as several firms report active preparations with a view to restarting rolling mill plant within the next two weeks. A moderate demand has been in evidence this week, and in all sections of the steel market prices keep firm, the feeling being, moreover, that conditions of supply

and demand will favour continued firmness for some time yet. Current quotations for joists and sections range from £7 17s. 6d. to £8 per ton delivered, with the latter figure more generally quoted, whilst boiler plates are at £11 10s., ship and tank plates at £8 17s. 6d. to £9, basic bars at about £9, and small re-rolled bars at £9 5s. per ton. Offers of parcels in India at prices which are much lower than those that have been quoted here have had a very depressing influence on the market for galvanised sheets, current values on the Manchester market now being as low as £16 per ton f.o.b. for 24 gauge sheets, and there is a very poor demand even at that figure. It is perhaps too early yet after the holidays to tell how continental materials are likely to fare. At the moment, however, there is not much business stirring, although prices generally in this section have shown little or no alteration compared with last week.

Scrap.

There is little movement in the market for non-ferrous metal scrap, but except in copper, which is weaker in sympathy with the new metal, there is little change in prices. For delivery to buyers' works, heavy yellow brass is quoted at £45 per ton, brass rod turnings at £39 10s., selected gunmetal at £52 10s., braziery copper at £51, clean light copper at £55 10s., zinc at £25 to £26, and lead at £28—in all cases for graded materials.

BARROW-IN-FURNESS.

Pig Iron Production.

At last one can really speak of the hematite pig iron production. Barrow has got two furnaces in blast, Ulverston has one furnace working and another ready for lighting, and Carnforth has blown in one of its biggest furnaces. Millom is to the fore in production and there are two furnaces in blast at the Derwent works in Cumberland. The Backbarrow furnace is also at full production. The fuel difficulty is still present, and it will be a month or even more before the district as a whole is at maximum production. There is any amount of work for the iron-makers, and if all things work out as they should, the furnaces a year hence should still be active. There are undoubtedly signs of a revival of trade, and there are eight months' idleness to pick up as well. That condition of things makes for a firm market. Apart from ordinary qualities of pig iron, there is every likelihood of a steady trade in special iron with customers throughout the district. Fuel prices will, however, have to become easier before makers get into full swing, for much of the present and future deliveries were booked at prices which will not allow of heavier costs for fuel than obtained before the coal stoppage. Some of the coke delivered during the last week or two was on pre-dispute contracts. There is the prospect of good business in ingot moulds, and already inquiries are satisfactory. The local iron ore business will follow the iron trade closely, and the better the iron trade is the better will be the activity in ore.

Steel.

The Barrow Steel Works are engaged upon rails, and are likely to be active in this direction for a considerable period. The hoop mills are well booked up, and they have a prospect of an uninterrupted run. The small section mills will also soon be producing. At Workington the mills are expected to be at work very soon on rails and sleepers.

Barrow Electricity Supply.

The Barrow Town Council discussed at some length this week the possibility of further pressing its claims upon the Electricity Commissioners with regard to the Backbarrow hydro-electric scheme, which the Commissioners turned down a few months ago. At one time it was thought that there was a majority in favour of going on with the Backbarrow scheme, but finally there was a majority in favour of obtaining powers to spend about £60,000 on the extension of the existing power station. It remains to be seen whether the Commissioners still favour the idea of Barrow obtaining an extra supply from Vickers Ltd., who possess power station resources sufficient not only for their own needs, but also for the Barrow district. Many members of the Town Council prefer to be independent and generate their own power rather than be beholden to a private firm.

SHEFFIELD.

(From our own Correspondent.)

The Pre-Strike Level.

THE heavy steel industry of this district is now fast getting back to the pace at which it was working before the dislocation caused by the coal strike. After more than six months of idleness, open-hearth furnaces have been restarted at most of the large works, and the quantity of steel being melted at present is almost equal to that of the days immediately before the stoppage. Altogether, about forty furnaces are working. The concern with the largest output is the United Steel Companies, which has eight furnaces fully occupied at Templeborough and five at Rotherham. The company's billet mill at Templeborough is also in operation. At the Park Gate Ironworks, melting will be resumed as soon as the blast-furnaces are assured of a larger and more reliable supply of coke. Melting is proceeding at the various other works which I mentioned last week. Prospects of work are sufficiently good to warrant the restarting of still more furnaces, but a cautious policy must be pursued until pig iron is available in larger quantities. At present there is not enough of this material, and the prices are considerably higher than before the strike. The prospects of production on a large scale are improving, however. The price of coke has come down to a level which, although substantially more than that of April last, enables owners of blast-furnaces to complete their plans for resuming operations. During the past week there have been large purchases of coke at 18s. or 19s. per ton, as compared with 13s. 6d. to 14s. 6d. before the strike. It is expected that supplies of pig iron will be normal by the end of this month or early in the next. The resumption of work at the local bar iron manufactories, like that at the steel works, is now almost up to normal.

An Encouraging Outlook.

The outlook for the iron and steel trades is considered good, and some authorities predict that the present year will be the best since 1921. Prophecies of this kind have been made before, and have unfortunately proved over-sanguine, but there do appear, on the present occasion, to be solid grounds for confidence. All the firms in the heavy branches have already on hand work sufficient to last for several months, and this consists not only of old contracts but of orders which have been booked recently and which are still being received. Higher prices are being charged for new orders, but the increases are moderate and do not much more than cover the additional cost of fuel and pig iron. At the same time, selling prices should come down a good deal if a continuance of good trade, especially overseas, is to be assured. There is a good prospect of improvement in the export markets owing to the appreciation of continental currencies, which has a tendency to raise costs of production in the countries concerned and also to assist their import trade.

The Finished Trades.

At the moment, the light steel branches, and those engaged in the manufacture of finished products, are not enjoying an activity equal to the heavy side. These sections were able to run to a greater or lesser extent during the stoppage, but at present they report a quiet time, the flow of orders having fallen off appreciably soon after the settlement. While the file trade shows a considerable recovery, and the demand for some kinds of tools is good, orders for engineers' tools are only light. No undue importance is attached to the present falling off, however. It is regarded as only a temporary reaction, and the generality of tool makers are looking forward to a good year. The disappointment which was felt in the closing months of last year at the absence of Russian business was relieved, to a large extent, just before Christmas, when orders for a good bulk of files, saws and several other classes of tools came to hand. The quantity of files required ran into a good many thousands of dozens. As the goods were wanted for delivery early in the New Year, the work was distributed among a considerable number of firms, and the orders have now been executed.

Wire Rope and Wire.

The scarcity of wire-making material is now being overcome. The wire rod mill at Templeborough, which is capable of turning out about 1500 tons of rods per week, has been restarted, as has also W. Cooke and Co.'s mill; while J. H. Andrew and Co. and other firms, which were at work during the strike period, continue their operations. It is considered that there is a favourable outlook for the wire industry, and especially for the best qualities, in which the Sheffield district specialises. The wire rope branch enjoyed a good demand on export account during the strike, and that demand is still maintained, and augmented by resumed buying on the part of home colliery companies. Although competition in the wire rope trade is fairly severe at home, there is not a great deal of foreign rivalry to face, and it is probable that local rope makers will be well employed throughout the present year.

Cammell's Cruiser Order.

Cammell Laird and Co., Ltd., of Sheffield and Birkenhead, who are at present completing the hull and machinery of the battleship Rodney, have received a valuable order from the Admiralty for a complete set of main and auxiliary machinery for a cruiser to be built at the Portsmouth Dockyard. Messrs. Cammell have issued their annual report on the past year's activities and present prospects, which shows that they have on hand substantial orders for railway stock of various kinds. One interesting item relates to 160 steel coaches for the electrified service on the Bombay, Baroda and Central India Railway, which are being built at their Nottingham works. The gauge is 5ft. 6in., and the coaches will be 68ft. long and 12ft. wide. Coaches which are built for export are, as a general rule, taken down after erection and testing, and packed in cases for shipment. This method is not to be adopted, however, in the case of the coaches mentioned. They are, instead, to be shipped as complete steel shells, while the woodwork and interior trim will be fitted in India. As the coaches are too large to be handled in an erected state by the home railways, they are to be transported in barges constructed for the purpose *viâ* the river Trent to Hull, where shipments will be made in special steamers.

The Cutlery Trade's Year.

Most of the firms engaged in the cutlery trade, and also in the kindred one of electro-plate, report that the past year yielded better results than in view of the difficulties caused by the coal strike, had been anticipated. There was a substantial recovery of business in the closing months, which were almost up to the normal. The losses in sales, caused by the decline in the early stages of the stoppage, were to a large extent made good. There is a fair amount of work on hand at present, and an improved year is looked forward to.

New Coke Ovens at Parkgate.

The South Yorkshire Chemical Works, Ltd., Parkgate, is making considerable extensions to its plant. To its original installation, of 85-waste heat coke ovens with by-products recovery plant, it is adding a battery of Semet-Solvay regenerative ovens of the most up-to-date construction and equipment, which will introduce the latest features of American practice. The installation is designed to coke, and recover tar, ammonia, and crude benzol from coal. The ovens are of 12 tons capacity. The hot coke will not be quenched on pushing out, but will be run to a quenching station by means of an electric locomotive. After quenching it will be slid on to a wharf, and thence drawn by feed rollers and carried by a rubber band conveyor to a screening and sizing plant. Every fifteen minutes there will be a cycle of the operations of charging, levelling, pushing, and quenching a charge. The breeze separated from the coke will be used to raise all the steam required by the plant in Babcock and Wilcox boilers operated at 160 lb. pressure.

A Waterworks Extension.

The Derwent Valley Water Board has deposited a parliamentary bill by which it seeks power to construct an aqueduct through the rural district of Belper from the existing aqueduct in the parish of Dethick Lea and Holloway to a junction with the existing aqueduct in Crich.

NORTH OF ENGLAND.

(From our own Correspondent.)

A Bright Outlook.

AFTER the disastrous experience of last year, one is somewhat reluctant to prophesy regarding trade prospects for the year just entered upon, as calculations are so easily upset nowadays. Last year the faint glimmerings of trade recovery were utterly quenched by the miners' dispute, the effects of which are still being seriously felt in many directions, but it is greatly to be hoped that, at long last, the country will now enjoy a prolonged period of industrial peace. Without industrial peace there can be no hope of a return to prosperity. There is, however, good reason to believe that workers generally are at last beginning to realise the utter folly and futility of strikes, and if this is so, there can be no doubt that good progress will be made along the difficult path of trade recovery. The New Year has certainly opened with an optimistic feeling in industrial circles in the North of England, and it is to be earnestly hoped that the trade revival which has taken shape during the past two months will not be rudely shattered by industrial disturbances. So rapidly are operations being resumed at the iron and steel works that production promises to return to normal sooner than was expected, but commodities cannot become available in large quantities for the open market until the heavy arrears of deliveries have been considerably overtaken. The outlook generally is, however, distinctly bright and encouraging, and while nothing in the nature of a "boom" can be looked for, gradual sound trade development is confidently anticipated. Manufacturers in all branches have quite good order books, and though there is still a feeling of uncertainty as to levels at which values are likely to settle, more inclination to negotiate for forward supplies is noticeable, and there seems a good prospect of brisk forward business during the first quarter of the year.

Cleveland Pig Iron.

There are now thirty-six furnaces in blast or about to restart on the North-East Coast, and although most of the iron will be required for the steel works, it should soon be possible to meet consumers' early needs. Business has ruled on quiet lines this week, but the tone of the market has been quite cheerful, and a fair number of inquiries have been circulating. As production increases and the supply of coke becomes more adequate to the needs of industry prices are becoming a little easier. The quotation for early deliveries of No. 3 G.M.B. Cleveland pig iron is now no more than 85s. per ton, and 82s. 6d. per ton would be accepted for three months' contracts. No. 1 foundry iron is quoted at 87s. 6d. per ton, No. 4 foundry 84s., and No. 4 forge 83s. per ton, all for January delivery. Export prices of Cleveland iron are nominally 6d. per ton more than the home price, but actually there is no iron available for export, nor is there likely to be for some little time. Few of the blast-furnaces are as yet turning out suitable iron, and there is still an insufficient supply to meet home requirements, which naturally have first claim. Practically the whole of the contracts suspended during the strike have yet to be implemented, so that there will be heavy calls on makers for some time to come.

Hematite Pig Iron.

There is still a great scarcity of hematite pig iron, but the output is being increased, and for forward deliveries 90s. per ton will be accepted for mixed numbers, though more has to be paid for small prompt lots.

Ironmaking Materials.

Business is showing signs of revival in the foreign ore trade, but there are still big deliveries to be made under old contracts. Buyers, however, regard present prices as too stiff. The Bilbao-Tees freight is down to 7s., but the mineowners are inclined to stiffen prices, and are quoting 23s. per ton for best Rubio ore, c.i.f. Tees. Blast-furnace coke is very scarce and dear. Some of the makers are asking 27s. 6d. per ton delivered, and certainly 25s. is a minimum figure which many sellers refuse to accept.

Manufactured Iron and Steel.

Great activity prevails at the manufactured iron and steel works. Here and there a shortage of ingots is reported, but there is any amount of work, and new orders are coming along in good volume. Prices are firmly maintained.

Iron and Steel Exports in 1926.

A glance at the exports of iron and steel from the Cleveland district during the past year reflects the extent of the injury inflicted by the coal stoppage. The total for the year is returned at 647,309 tons, or about 34 per cent. less than in the previous year, and about one-third of the 1913 figure. The decline was, of course, most marked in regard to pig iron. There was, in fact, insufficient pig iron for home requirements, and the export of 183,000 tons of pig iron from the Tees during 1926 is almost exactly half

the tonnage in 1925, and about one-seventh that of 1913. Steel shipments, on the other hand, only declined from 627,379 tons to 454,309 tons, a drop of about 25 per cent., and as compared with 1913 the decline is no more than about 34 per cent. The fact is that there has been a gradual change in the nature of Cleveland's export trade. There has been a permanent contraction in the tonnage of pig iron exported and a growing volume of manufactured iron and steel, and from an examination of past records the surprising fact emerges that, notwithstanding the industrial paralysis of the past year, the Tees exports of manufactured iron and steel exceeded those of any year from 1916 to 1922 inclusive. The statistics again indicate the immense potentialities of the South American markets, to which about 47,000 tons of steel were shipped; whilst India and Ceylon, despite the tariffs, were the best customers, taking approximately 133,000 tons of steel material. Pig iron shipments declined in every direction. Scotland took less than half of the 1925 quantity, and to most other countries the shipments declined 50 per cent. or more.

The Coal Trade.

A quiet tone characterises the Northern coal trade. There are inquiries for coking coal from abroad, particularly from Belgium—Ghent, among other places, having invited offers for 10,000 tons—but there is little movement in other sections. The foreign inquiry has not yet opened out, and when it does there is likely to be keen competition. Advices from the Continent indicate that the position is so difficult at the moment that it is next to impossible to sell English coal at all. It would appear that customers abroad are holding off for two reasons. They still have stocks in hand, and they are waiting for British prices to come down. The prices generally quoted are still above competitive prices abroad, and to merchants' offers replies come to hand with much lower counter offers. Reports from all the pits state that work is in full progress, and that the outputs can be readily increased to meet any volume of business. The lack of demand from the large London gas companies tends to weaken the market for gas coals. Steam coals are just in a moderate position, and best qualities move slowly at about 19s. 6d. to 20s. Tyne primes and similar classes are steady at 19s. For small steams the market is weak, bests being about 13s. and ordinary 12s. to 12s. 6d. Best Durham gas coals are quoted from 20s. to 21s. Output of coke is increasing, and the demand is heavy. Gas coke is 30s., and patent foundry coke 32s. 6d.

SCOTLAND.

(From our own Correspondent.)

Holiday Influences.

FOR some days before the holidays and during the present week markets have been more or less under the influence of the holiday feeling. Business has been practically at a standstill, producers in some trades being wholly engaged clearing up existing orders, while others have been either stocktaking or considering arrangements for a restart of operations where works have been closed since the end of the coal strike and for some time previous.

Prospects.

Granted a quick return to economic rates for fuel and immunity from labour troubles, the outlook for the present year is comparatively satisfactory. Apart from orders held up during the past six months, many new contracts for ships, structural material, &c., have been placed, and there seems every reason to anticipate a steady degree of all-round activity in the months to come. The question of foreign competition in overseas markets and to some extent in home markets also, still presents a stiff problem, which becomes increasingly difficult of solution under present-day working conditions of restricted hours and outputs. Increasing oncosts with their resultant effect on prices have forced home consumers of certain materials to substitute either other home products or to utilise materials of foreign origin. On the other hand, some products have experienced an unprecedented demand, and the foregoing remarks may serve to indicate the great revival in industry that might take place should certain obstacles be removed.

Steel and Iron.

The past year in the iron and steel industries was an unsatisfactory one for reasons obvious to all. A feeling of uncertainty prevailed right from the early weeks of the year until the upheaval in May, from which time trade became practically impossible in most materials. The turnover in heavy steel suffered severely, all the works remaining closed for at least six months. Orders were received, but production was impossible, owing to fuel costs. Bar iron was similarly placed, and any works in operation were wholly engaged producing steel bars from foreign billets. After the first week or two of the strike, the production of pig iron ceased altogether. In any case, owing to reduced demands, less than a dozen furnaces were in blast at the end of April, compared with about eighty-five in former years of normal trade. Throughout this whole period an exception to the prevailing stagnation was provided by the steel sheet industry. The demand for black and galvanised sheets, especially the latter for export, reached abnormal dimensions, and the year closed with makers fully booked up for some time ahead. At the time of writing, one or two steel works have been restarted and preparations are going forward at other establishments. Almost all the bar iron works are in operation on a more or less restricted scale, with chief activity in the steel department. Some six pig iron furnaces have been re-lit, and this number will be augmented within the next few weeks, as supplies of pig iron have now reached vanishing point. Owing to present levels of prices, consumers continue to act warily, but there is every indication of fairly substantial orders to be placed when quotations are more stable.

Coal.

Before the holidays the collieries were busy clearing off commitments due for shipment before the end of the year, and although fresh business was extremely slow, the market retained a firm tone, only a slight weakness being noticeable in certain washed materials for export. For land sale prices closed as follows:—Screened steam, 22s. 6d. to 25s.; unscreened, 16s. 6d. to 18s.; treble nuts, 23s. 6d. to 24s.; doubles, 21s. 6d. to 22s. 6d.; singles, 17s. to 18s. 6d.; pearls, 13s. 6d. to 15s.; and dross, 12s. 6d. to 15s.—all per ton f.o.t. at pit. House coal continued unchanged at 24s. to 32s. 6d. per ton at pit. Compared with the year 1925 the total shipments of Scottish fuel from Scottish ports during 1926 showed a decrease of over 6,500,000 tons, at 5,591,088 tons. In view of the fact that returns for the first four months of 1926 were higher than in the same period in 1925, the above figures probably do not indicate the ultimate loss to the shipping department.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE conditions in the steam coal trade are comparatively quiet, but that is no more than was expected, for the reason that the foreign demand is held in check pending prices coming down to a lower level. Small cargoes are being arranged here and there for fairly early shipment, but consumers abroad are in most cases deferring operating on anything like an appreciable scale until they feel convinced that prices have touched what may reasonably be considered the bottom. As a matter of fact, values are gradually giving way, but there is no eagerness so far on the part of buyers to purchase extensively. The position is therefore that, with expanding production, some collieries are finding it difficult to secure a quick outlet for their coals, and the situation is not helped by the fact that foreign coals, which are still being received from America, India and the Continent, are taking up railway wagons which are needed by the colliery undertakings. This week there are still over a dozen steamers in dock discharging substantial cargoes of foreign coals, and those coals require a considerable amount of rolling stock. Furthermore, there is more than the usual quantity of wagons employed at the moment in the inland trade, so that collieries in this district are not as well placed as under normal circumstances, and these facts are operating against the market for Welsh coals.

Egyptian State Railways Contract.

There was much speculation during the whole of last week as to what would be outcome of the recent tendering for the supply of locomotive coals for the Egyptian State Railways. It was reported that although the authorities had asked for prices for 160,000 metric tons for delivery at Alexandria during February, March and April, only part of the order for 50,000 tons had been placed. Even that could not be confirmed, and it now looks, from the information obtained locally and from sources at Cairo, as if the railways have not booked any coals at all, but have cancelled altogether the adjudication, and are coming in the market again for fresh tenders for 100,000 tons. It is stated that the fresh tenders have to be at Cairo on the 20th inst. The lowest tender submitted on the last occasion, viz., December 18th, was 36s. c.i.f. Alexandria for Welsh coals. It is naturally assumed that the railways were not satisfied with the prices which were recently sent in, and that they expect, by calling for fresh prices, to secure offers appreciably below the last figures. Certainly the coal market has weakened materially since collieries and exporters made their last offers, but it is questionable whether the c.i.f. prices that will be sent in for the forthcoming adjudication will show a very substantial reduction, for the reason that while coal prices have weakened, freight rates display a tendency to move upward.

Steel and Tin-plate Trade.

The situation in the tin-plate and steel trade is slowly improving. This week it is calculated that fully 70 per cent. of the tin plate mills will be in operation, while there is every prospect that the Port Talbot Steelworks will resume operations shortly. These works have been idle for close on two years, but the official announcement is made that the furnaces will be lit up soon, and that work will be in full swing by the end of January. Under normal conditions these works employ approximately 1200 men. On the other hand, there is very unsatisfactory news from Swansea, where owing to the position in the steel industry generally Sir William Arrol and Co., Ltd., are closing their structural works. These works were opened about four years ago. An important contract secured recently by the company for South Africa and New Zealand, estimated to be of the value of about half a million pounds sterling, is to be transferred to Sir William Arrol and Co., Glasgow, who are also taking over the services of certain members of the technical staff to deal with the work.

"Gueret, Llewellyn and Merrett, Ltd."

Although no official statement is so far forthcoming concerning the merging of the two big undertakings of L. Gueret, Ltd., and D. R. Llewellyn, Merrett and Price, Ltd., of Cardiff, steps towards amalgamation have been advanced by the fact that notices have been issued to the shareholders of the former company calling extraordinary general meetings for the 12th and 28th inst. at Cambrian-buildings, Cardiff Docks, to consider resolutions to change the name of the company and to increase the capital. The proposed new name is Gueret, Llewellyn and Merrett, Ltd., and it is also proposed to increase the capital from £1,500,000 to £2,000,000 by the creation of an additional 500,000 shares of £1 each. Mr. T. J. Callaghan is to be the chairman of the company, and Mr. H. H. Merrett the managing director. The latter is one of the most enterprising men in the coal trade to-day. Although only forty years of age, he is now at the administrative head of a concern which has the marketing of coal and fuel amounting to between ten millions and twelve million tons annually. His advance from a position of ordinary clerk in a colliery office to his present eminent position in the space, comparatively speaking, of a few years has been phenomenal. He has a prodigious capacity for work and a remarkable grasp of detail.

Reinstatement of Miners.

The first meeting of the Joint Standing Disputes Committee for the South Wales coalfield on Tuesday came to an abrupt termination on the question of the reinstatement of miners. There were several disputes to be considered, and in one case where the men's representatives stated that it had always been customary after a stoppage to re-employ the men by order of seniority, the coalowners' representatives declined to interfere with the discretion of the management in the employment of individual workmen. The men's leaders intimated they could not accept the owners' interpretation of the declaration given regarding re-employment when the coalfield agreement was come to, and they refused to proceed with the remainder of the cases down on the agenda for discussion.

Stabilising Prices of Coal.

The continued fall in coal prices has caused the Commercial Committee of the South Wales Coalowners' Association to consider the question of co-operative action among salesmen for the purpose of stabilising prices and prevent unnecessary reductions. The same Committee has also invited the South Wales Exporters' Association, the Shipowners' Association and Shipbrokers' Associations to attend a conference to consider and decide whether a committee of all these organisations should be set up to deal with all questions arising from time to time in connection with the export trade.

Current Business.

The tone of steam coals is quiet, and prices are slowly sagging except in the case of some of the special descriptions, of which the output is comparatively small. Best Admiralty large coals were quoted recently at over 30s., but to-day the price is nearer 27s. 6d. to 28s., with ordinary Admiralty large coals ranging about 25s. to 26s. Small coals are fairly plentiful and are offered at round about 17s. for superior qualities, while inferior sorts rule down to 13s. to 14s. House coals have been reduced as from the 1st inst., best qualities being lowered to 32s. 6d. per ton at the pithead, which is a reduction of 7s. 6d. per ton, and brings the figure down to the level prevailing in April last. Patent fuel remains without material change, but pitwood is easier on account largely of the fact that wagons are so scarce into which to discharge supplies. Prices are round about 32s. 6d. to 33s.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THOMAS AND SONS, Ltd., of 36, Queen-street, London, E.C. 4, have, owing to the death of Mr. John Gibson, of 63, Coleman-street, E.C. 2, been appointed agents for the publications of McCorquodale and Co., Ltd., and also for Crichton's Calculating Books.

JAMES GORDON AND CO., Ltd., of Windsor House, Kingsway, London, W.C. 2, ask us to state that they have made arrangements with the Swedish A/B Finshyttan for the manufacture in this country of propeller type turbines in accordance with that company's patents.

ANDERSEN, MEYER AND CO., Ltd., engineers, contractors and importers, whose head offices are at Shanghai, have opened London offices at No. 30, Mincing-lane, E.C., where Mr. S. H. Morden, lately general manager to J. Whittall and Co., Ltd., will be in charge.

WILLIAM SHEPHERD AND SONS, Ltd., of Milkstone, Rochdale, ask us to announce that Sir Arthur R. Knapp has been appointed chairman of directors and that an association of interests has been effected between themselves and Wake and Co., Ltd., of Port Clarence, near Middlesbrough.

THOS. W. WARD, Ltd., of Sheffield, has purchased—for dismantling and selling the contents for re-use—the Kent-street Oil Mills, Liverpool, formerly belonging to A. M. Smith and Co., Ltd. seed and copra crushers and edible oil refiners, and latterly worked by Messrs. Hilditch and Young, who went into liquidation some time ago.

MR. W. VINCENT WAITE, M.I. Mech. E., A.M.I.E.E., advises us that he has resigned his position of London manager to Clayton Wagons, Ltd., and Clayton and Shuttleworth, Ltd., and requests that communications shall be addressed to him at the following temporary address, Room 75, Empire House, 175, Piccadilly, W. 1.

A JUBILEE OF SERVICE.—On December 29th Mr. Stanley Howard Hodgkin, joint managing director of the Pulsometer Engineering Company, Ltd., of Reading, completed fifty years' service with the firm. To mark the occasion, a dinner was given at his house at Reading, which was attended by members of the staff who had an average service of twenty years with the company. By the co-operation of Mrs. Hodgkin, the arrangements were kept secret from Mr. Hodgkin till the last moment, and he became the guest of honour in his own home. Opportunity was taken by the directors and staff of the company to present mementoes of the occasion to him, together with an engrossed letter from the staff as a permanent expression of their regard.

THE ENGINEERS' LEAGUE CHALLENGE SHIELD FOR RIFLE SHOOTING.—The Engineers' League is organised for the purpose of an annual contest between teams of six drawn from any affiliated club connected with the engineering industry, the trophy being the Society of Miniature Rifle Clubs Engineers' League Challenge Shield. The contest provides for twelve matches each for thirteen teams, and last year's competition concluded in favour of the Great Eastern Mechanics' Institute, which won the shield and six silver medals with the high average of 581·58 out of 600, despite a reduction in the size of the target. Upper Mills came second with 577·16 and received bronze medals. The S.M.R.C. is the central authority for regulating the movement in Great Britain, and as showing how fast that movement is spreading in every part of the country it is interesting to note that about 1600 local miniature rifle clubs and associations are affiliated to the parent body, the address of which is 15, Arundel-street, London.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 10 0	—
No. 1 Foundry	4 15 0 to 5 0 0	—
No. 3 Foundry	4 12 6 to 4 15 0	—
N.E. COAST—		
Hematite Mixed Nos.	(c) 4 10 0	4 10 0
No. 1	(c) 4 11 0	4 11 0
Cleveland—		
No. 1	(c) 4 10 0	4 10 6
Silicious Iron	(c) 4 10 0	4 10 6
No. 3 G.M.B.	(c) 4 5 0	4 5 6
No. 4 Foundry	(c) 4 4 0	4 4 6
No. 4 Forge	(c) 4 3 0	4 3 6
Mottled	(c) 4 2 0	4 2 6
White	(c) 4 2 0	4 2 6

(c) *January - February Delivery.*

MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
„ „ Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	4 0 0 to 4 2 6	
„ Forge	—	—
(3) Derbyshire—		
No. 3 Foundry	4 5 0	—
Forge	—	—
(3) Lincolnshire—		
No. 3 Foundry	4 5 0	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 15 6 (a); 4 18 6 (b); 5 2 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 0 0	11 15 0
Best	—	—
N.E. COAST—		
Common Bars	12 5 0	—
LANCS.—		
Crown Bars	12 10 0	—
Second Quality Bars	11 5 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	12 15 0	—
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 5 0 to 11 10 0	
Gas Tube Strip	15 0 0	—

STEEL.

	(5) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ½in. and up	8 7 6	7 0 0
Sections	7 17 6	6 5 0
Steel Sheets, under 3/16in. to ½in.	12 10 0 to 13 10 0	
Sheets (Gal. Cor. 24 B.G.)	—	£16 10 0 to 17 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 17 6	—
Angles	8 12 6	—
Boiler Plates	12 10 0	—
Joists	8 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0†	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0†	
MANCHESTER—		
Bars (Round)	9 0 0	—
„ (Small Round)	9 5 0	—
Hoops (Baling)	11 0 0	11 0 0
„ (Soft Steel)	10 15 0	10 15 0
Plates	8 17 6 to 9 0 0	
„ (Lancs. Boiler)	11 15 0	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0	—
Bessemer Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	8 0 0	—
Hoops	12 0 0	—
Soft Wire Rods	10 0 0	—
MIDLANDS—		
Small Rolled Bars	8 15 0 to 9 0 0	
Billets and Sheet Bars	—	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 5 0	—
Angles	8 0 0	—
Joists	8 0 0	—
Tees	9 0 0	—
Bridge and Tank Plates	—	
Boiler Plates	—	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	20/3 to 21/6
Block Tin (cash)	301 0 0
„ (three months)	295 0 0
Copper (cash)	55 17 6
„ (three months)	56 12 6
Spanish Lead (cash)	28 8 9
„ (three months)	28 12 6
Spelter (cash)	32 7 6
„ (three months)	32 8 9
MANCHESTER—	
Copper, Best Selected Ingots	62 17 6
„ Electrolytic	62 12 6
„ Strong Sheets	92 0 0
„ Tubes (Basis Price) lb.	0 1 1
Brass Tubes (Basis Price) lb.	0 1 0
„ Condenser lb.	0 1 2½
Lead, English	29 12 6
„ Foreign	28 7 6
Spelter	32 7 6
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
„ „ 6 p.c. to 8 p.c. „	£22 0 0	7/3
„ „ 8 p.c. to 10 p.c. „	£20 12 6	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 0 0	12/6
„ „ „ 1 p.c. „	£42 0 0	15/-
„ „ „ 0·70 p.c. carbon	£54 0 0	17/6
„ „ „ carbon free	1/5d. per lb.	
Metallic Chromium	3/- per lb.	
Ferro Manganese (per ton)	£16 for home, £16 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 7 6	scale 5/- per unit
„ „ 75 p.c.	£18 5 0	scale 6/- per unit
„ Vanadium	14/6 per lb.	
„ Molybdenum	5/- per lb.	
„ Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Cobalt	3/3 per lb.	

FUELS.

SCOTLAND.

(Prices not stable).

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	19/-
„ „ Ell	22/6
„ „ Splint	23/- to 25/6
„ „ Trebles	23/6
„ „ Doubles	21/6
„ „ Singles	19/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	20/-
„ „ Jewel	22/6
„ „ Trebles	24/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	19/- to 21/-
Screened Navigation	24/-
Trebles	25/- to 25/6
Doubles	21/6
Singles	20/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	19/6
Secondary Steam	18/6
Trebles	23/3
Doubles	21/-
Singles	21/6

ENGLAND.

	Export.
(8) N.W. COAST—	
Steams	28/-
Household	*No quotation.*
Coke	32/6
NORTHUMBERLAND—	
Best Steams	19/6 to 20/-
Second Steams	18/6 to 19/-
Steam Smalls	14/-
Unscreened	17/- to 18/-
Household	30/- to 36/-
DURHAM—	
Best Gas	21/-
Second	16/-
Household	30/- to 36/-
Foundry Coke	28/- to 30/-

	Inland.
SHEFFIELD—	
Best Hand-picked Branch	34/- to 35/- —
Barnsley Best Silkstone	30/- to 32/- —
Derbyshire Best Brights	30/- to 32/- —
„ „ House	28/- to 30/- —
„ „ Large Nuts	27/- to 29/- —
„ „ Small	22/- to 24/- —
Yorkshire Hards	20/- to 21/- —
Derbyshire Hards	20/- to 21/- —
Rough Slacks	11/- to 12/6 —
Nutty Slacks	10/- to 11/- —
Smalls	3/- to 6/- —
Blast-furnace Coke (Inland)	30/- to 35/- at ovens.
„ „ (Export)	f.o.b. 30/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	26/6 to 27/6
Second „	25/- to 26/-
Best Dry Large	26/- to 27/-
Ordinary Dry Large	25/- to 25/6
Best Black Vein Large	26/6 to 27/-
Western Valley Large	26/- to 26/6
Best Eastern Valley Large	26/- to 26/6
Ordinary „ „	24/6 to 25/6
Best Steam Smalls	16/- to 17/-
Ordinary „	13/- to 15/-
Washed Nuts	28/- to 31/-
No. 3 Rhondda Large	32/- to 33/-
„ „ Smalls	23/6 to 24/6
No. 2 „ Large	26/- to 27/-
„ „ Through	22/6 to 23/-
„ „ Smalls	17/- to 17/6
Foundry Coke (export)	45/- to 55/-
Furnace Coke (export)	40/- to 45/-
Patent Fuel	30/- to 32/6
Pitwood (ex ship)	28/6 to 29/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	45/- to 47/6
Seconds	35/- to 40/-
Red Vein	30/- to 35/-
Machine-made Cobbles	55/- to 60/-
Nuts	55/- to 60/-
Beans	47/6 to 50/-
Peas	29/- to 30/-
Breaker Duff	12/- to 12/6
Rubbly Culm	16/- to 17/-
Steam Coals :	
Large	26/6 to 27/6
Seconds	25/- to 26/-
Smalls	12/- to 14/-
Cargo Through	19/6 to 21/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. † Latest quotations available.

(a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Weaker Prices.

AFTER holding out as long as they could against the influences which tend to bring down prices, iron and steel producers are offering supplies at lower rates, and yet they are unable to attract business, which remains absolutely at a standstill. Very little material is going into consumption, partly because the export trade has been seriously jeopardised by the deflation of the franc, and there are many instances of considerable foreign orders having been cancelled. Unemployment is certainly increasing, and measures are being taken to put in hand public works to avoid the necessity of paying out dole to the men. The year is being entered upon with feelings of grave concern, for there is nothing to give promise of a favourable change in the situation, and no improvement can be looked forward to so long as there is a possibility of further violent fluctuations to the franc. The work of financial readjustment has not yet proceeded far enough to inspire general confidence. The only thing that can be regarded as satisfactory is the increasing importation of British coal which, it is hoped, will ease the situation, and it is curious that while a few months ago it was confidently believed that German coal had finally ousted British fuel from the market, it is now seen that imports from Britiain are necessary to the very existence of home industries. The importation of British coal is also facilitated by the attitude of French coalowners, who refuse to make any concession in prices, which is regarded as inexplicable in face of the foreign competition, for British coal is being offered at prices which compel consumers to purchase it in preference to the French fuel. As a matter of fact, French coalowners cannot make any notable reduction without sacrificing their small margin of profit.

Railway Standardisation.

When he became Minister of Public Works soon after the Armistice, Monsieur Claveille, one of the most eminent French railway engineers, created an Office Central d'Etude de Matériel de Chemins de Fer, composed of engineers from the five big railway companies, with the idea of settling upon a plan for standardising rolling stock and railway equipment generally. At that time the whole of the system required reorganisation, which it was hoped to accomplish in a way whereby considerable economies could be effected in the cost of wagons and the whole method of signalling would be simplified. The problem presented more difficulties than had been anticipated, for each company works under special conditions, which makes the types of coaches employed on one line unsuited for another. On the Nord stoppages are frequent, and the corridor coaches have a door for each compartment, so that passengers can get in and out in the shortest possible time. On the P.L.M. and the P.O. the doors are at each end of the coach. Thus the Nord is unable to adopt the most economical type of coach. A solution of this problem was further held up by by the difficulty of coming to a decision over the question of whether the coaches should be constructed entirely of metal or of wood, or whether they should be built up with both materials. Vehicles of all types are now running experimentally, and on the State railways there is now a number of steel coaches. It will probably be a long while before any definite decision can be come to as to the method of coach building to be employed, and until then there can be no question of standardisation. The advantage of such uniformity from the point of view of economy has been proved by the considerable reduction in the cost of trucks since the companies were able to standardise a 20-ton type. They are, of course, not general, as they only replace trucks that go out of service. The attempt to standardise signals has also failed so far on account of the complexity of the problem, for no system has such a pronounced superiority over another as to justify its general adoption, and a great deal of experimental work is now being carried out with signalling devices. It is argued that one drawback to any drastic change would be in getting the railwaymen accustomed to the new methods, while the cost would be considerable. A standard system of signalling can only be imposed when some method is found to possess sufficient advantages to justify the change. The experimental electric signals on some of the Paris suburban electrified lines appear to be giving good results. They consist in an arrangement of red and white lights on a black panel, and are employed in conjunction with the usual discs, the whole being worked automatically. In this connection it is interesting to observe the experiments that are being made with the signalling of level crossings which exist everywhere in France. In these days of motoring they are a source of constant danger. At the approach of a crossing a white or red flash light shows whether the gate is open or closed. It is arranged to be plainly visible from a distance during the day. There are several types of lights on trial, generally worked automatically by the train. If the automatic controlling system fails the light comes to danger. It will obviously be some time before all these experimental devices give results that will allow of any definite signalling system being adopted.

Colonial Works.

In view of the necessity of providing employment at home, the Colonial Governments are preparing programmes of works which will involve the purchase of considerable quantities of machinery, railway and other material. In French West Africa a very large sum is to be spent during the next five years upon harbour works at Dakar, Konarky, Abidjan, Cotonou and Kaolack. The Thiès-Niger Railway is to be completed, while the section between Kayes and Niger is far too light for the traffic and must be relaid. In Dahomey, the Ivory Coast and Senegal Railways are to be constructed. Of great importance also are the irrigation works in the Niger and Senegal valleys, which offer particular interest and will provide engineering activity for a long while to come. This, however, will not entirely benefit French engineering, since it is hoped to carry out much of the work with the aid of material supplied by Germany on account of reparations.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

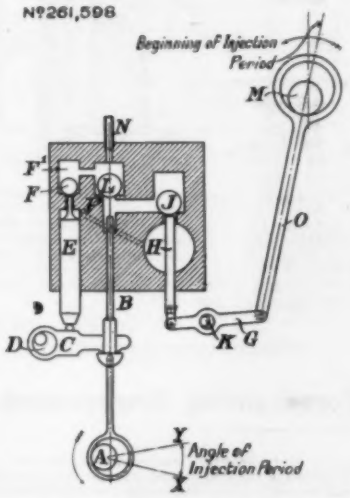
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

261,598. February 19th, 1926.—FUEL PUMPS, G. L. Kirk and F. E. Rebbeck, Harland and Wolff, Ltd., Belfast.

The fuel pump plunger B is operated from an excentric A or other suitable means in such manner that the pump plunger B makes two complete reciprocations for each complete four-stroke engine cycle, so that the pump plunger makes the same number of strokes as the main engine crank and piston. The plunger B also actuates a spill valve F through a tappet E and an arm C mounted on an excentric shaft D. An inlet valve J, which controls the suction passage of the fuel pump, is controlled by a tappet H operated by lever arm G mounted on an excentric shaft K and driven by a connecting-rod O from an excentric M or other suitable mechanism working at half the number of strokes of the pump plunger B. In the case of a two-stroke cycle engine, the inlet valve mechanism can either be arranged to make the same number of strokes as the pump plunger and engine piston, or the pump plunger may be driven at twice the speed of

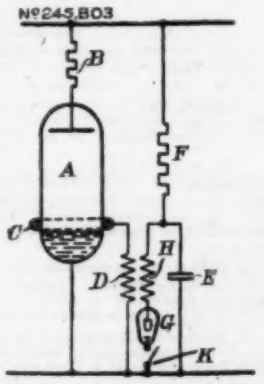


the engine piston and inlet valve mechanism. The inlet valve gear is so arranged that the inlet valve J is held off its seat during the idle stroke of the plunger B and also on part of the effective stroke until a point a few degrees before half stroke, when the valve J closes on to its seat and injection begins through the valve L and delivery pipe N, which opens directly into the relief valve chamber F^1. At a few degrees after half stroke the spill valve F is opened by the tappet E, acted on by plunger B, and allows the fuel to by-pass to the suction side through a return passage P. By this means the period of greatest velocity of the pump plunger, which is from X to Y, is utilised. For constant-speed engines governing or control would be through the spill valve F only, operating through excentric D, but in a propelling engine, where slow running is sometimes required, the lever G could also be mounted on an excentric K, whereby the time of the seating of the inlet valve J could be varied.—*November 25th*, 1926.

SWITCHGEAR.

245,803. January 11th, 1926.—IMPROVEMENTS IN OR RELATING TO THE IGNITION OF VACUUM SWITCH TUBES, Siemens and Halske Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

So-called switch tubes consist of vacuum or low-pressure gas tubes, by means of which heavy current circuits can be closed or opened. This invention relates to means for the ignition of these switch tubes—for example, mercury vapour tubes—and is characterised by the fact that ignition tension is generated with

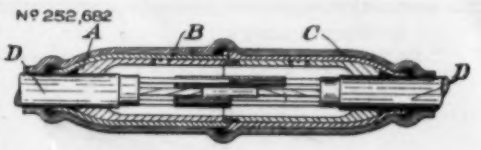


the aid of electron discharge tubes, such as thermionic tubes and neon lamps. In the diagram A is the mercury vapour tube, by means of which the load resistance B is switched in. C is the ignition pole, which is supplied with ignition tension through the coil D. E is a condenser which is charged through the high ohmic resistance F. This capacity can be discharged by means of the switch K through a discharge tube G—for example, a neon lamp and a choking coil H. When the switch K is closed the capacity is discharged through the tube G and the inductance H. Owing to this discharge ignition tension is produced in the coil D. After the discharge the capacity becomes charged again and the operation is repeated. The sequence of the single ignition impulses can be regulated by suitable dimensioning of the resistance F and the capacity E.—*November 25th*, 1926.

TELEGRAPHS AND TELEPHONES.

252,682. April 9th, 1926.—JUNCTION SLEEVE FOR DEEP SEA CABLES, Felten and Guilleaume Carlswerk, Actiengesellschaft, of Köln-Mülheim, Germany.

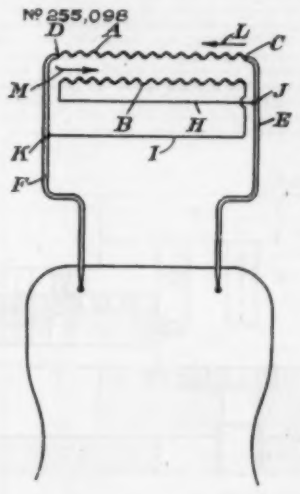
According to this specification, recent investigations have shown that the junction sleeves of deep sea cables which serve for accommodating the junctions of self-induction coils are



of doubtful value when constructed on the ordinary lines, for where there are very high water pressures all metals gradually allow the passage of traces of water. The junction box designed to overcome this trouble is illustrated, where A is a bronze casing, B a protecting casing of lead, and C a layer of gutta percha, which may extend beyond the lead covering D of the cable.—*November 25th*, 1926.

255,098. July 10th, 1926.—IMPROVEMENTS IN VALVES FOR USE IN WIRELESS TELEGRAPHY, Jacques Antoine Marie Hawadier, of 79, rue Boissière, Paris, France.

This invention relates to valves for use in wireless telegraphy, and is specially designed to allow of the employment of alternating current or in general of the current of the district supply for heating the filament. The valve has two filaments A and B, which are absolutely identical. A is connected in the usual manner at C and D to current conductors E and F leading from the base of the valve. The second filament B is connected at J and K to the same conductors E and F by wires H and I,

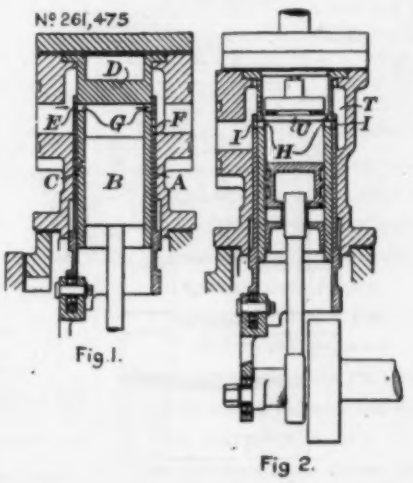


which do not become red and consequently do not cause an emission. The current divides at J into two parts, one of which passes through the filament A in the direction of the arrow L and the other of which passes through the filament B in the opposite direction, i.e., the direction of the arrow M. When an alternation takes place and the current changes its direction, the two directions of the current in the two filaments reverse, but they always flow in opposite directions to one another. As the two electron-omitting filaments are identical in construction, their effects compensate one another exactly in the two cases, and everything proceeds as if no inversion of the current had taken place.—*November 25th*, 1926.

PUMPING AND BLOWING MACHINERY.

261,475. August 19th, 1925.—GAS COMPRESSORS, Sir A. S. Haslam, Union Foundry, Derby.

Two alternative arrangements for a sleeve valve for an



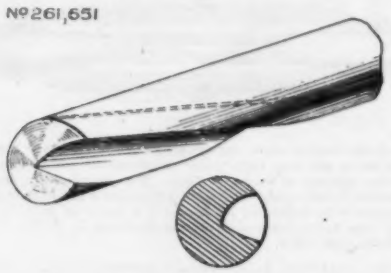
ammonia compressor are claimed for in this specification as follows:—In Fig. 1 A is a reciprocating sleeve arranged outside a cylinder C in which is a piston B. D is the cylinder head. In

the sleeve A are inlet ports E and outlet ports F placed at different levels, the cylinder C being provided with a set of ports G arranged in a ring round it. In Fig. 2 the outlet valve consists of an automatic spring-loaded valve which may be of the mush-room, or plate, type, while the inlet ports H and I in the cylinder and sleeve respectively communicate with an annulus T in the cylinder head, U being the outlet valve.—*November 19th*, 1926.

MACHINE TOOLS AND SHOP APPLIANCES.

261,651. July 1st, 1926.—TWIST DRILLS, T. A. Petrie, 10, Caledon-road, Sherwood, Nottingham.

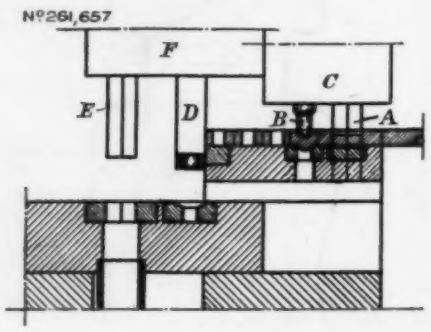
This twist drill has a single spiral cutting flute extending from the periphery to exactly the axis of the drill, as shown in the illustration. The advantages claimed are that drilling operations can be effected with less force and power and with greater facility



and accuracy than has been possible with existing forms of drills. The new drills also possess increased strength and durability. In order to provide adequate lubrication and cooling during the drilling operation a comparatively small and auxiliary flute or groove for facilitating the flow of the cooling liquid or lubricant to the drill point is provided.—*November 25th*, 1926.

261,657. July 12th, 1926.—NUT-MAKING MACHINES, A. de Fries, 10, Lessingstrasse, Cassel, Germany.

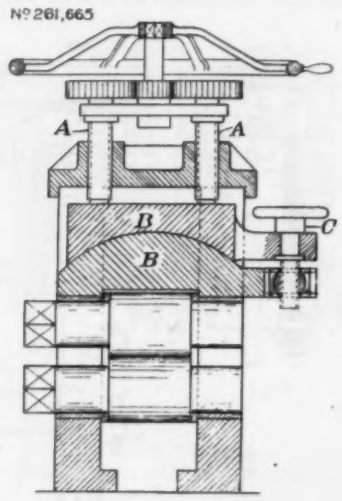
This specification is rather interesting on account of the lucid manner in which the objects of the invention are explained in the following terms:—In known automatic machines for making nuts from cold bar stock, the tools, viz., the notching punch, the holing punch, the shearing off and pressing tool and the finishing hexagon (or square) punch are all arranged in one operating slide. For making a nut the pressing and cutting or shearing off punch has to perform two operations at every revolution of the main shaft and consequently the tool slide makes two strokes, whereas the holing punch requires only one stroke



for performing its function. Owing to this arrangement the holing operation is very rapidly performed, and the holing punch, which, compared with the work to be done by it, has only a very small cross section, is subjected to heavy strain and often breaks. Experience teaches that the holing punch is also very heavily strained by its rapid return stroke. Similar drawbacks are caused by the rapid operation of the notching tool. In the machine of the inventor the notching die A and the holing punch B are mounted in one slide C, while the cutting-off and chamfer-ing die D and the finishing hexagon die E are mounted in a separate slide F so that the several operations can be timed in convenient sequence.—*November 25th*, 1926.

261,665. August 4th, 1926.—ROLLING MILLS, R. Kronenberg, Hans Kronenburg, Port Immigrath, near Cologne, Germany.

This invention is concerned with the rolling of thin strips of metal, which may be surrounded with difficulties on account of

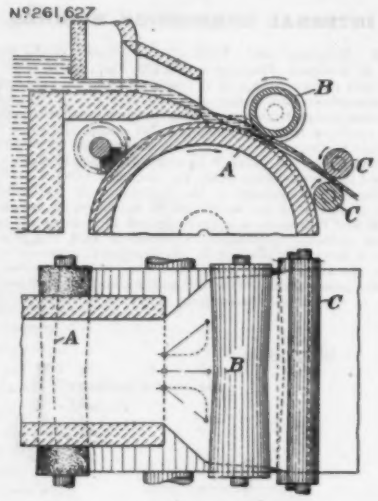


lack of parallelism of the rolls producing a curved strip. The roll housing is provided with the usual adjusting screws A A for determining the thickness of the strip rolled; but, instead of these screws pressing directly on the bearings of the upper roll, they abut on an intermediate pair of arc-shaped pieces B B. By the means of the adjusting screw C the straightness of the rolled strip can be maintained without varying its normal thickness.—*November 25th*, 1926.

MISCELLANEOUS.

261,627. May 31st, 1926.—FORMING SHEET GLASS, *L. Mellersh-Jackson*, 28, *Southampton-buildings, Chancery-lane, London, W.C.* 2.

This invention aims at the improvement of the process of rolling sheet glass so that the sides of the sheet may be of full thickness, a matter which has caused some trouble on account of the fact that the supply of molten glass must be in a fairly



thick stream in order to conserve its heat, while it must be spread in a thin sheet over the forming roll. The inventors consequently make the roll A with a convex face, while the roller B has a correspondingly concave face, as is plainly shown in the plan view. The result is that the molten glass slides downhill on the convex face of the main roll and consequently feeds the edges of the sheet, which are subsequently flattened by the pair of rolls C C.—*November 25th*, 1926.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—Engineering and Scientific Club, Queen-street, Wolver-hampton. Lecture, "Electrical Research," by Mr. W. Wilson. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Developments in the Carbonisation of Coal," introduced by Dr. C. H. Lander. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Distortion in Heat-treated Case-hardened Carbon Steels," by Mr. P. J. Haler. 7.30 p.m.

SATURDAY, JANUARY 8TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—College of Technology, Manchester. Paper, "The Heat Treatment and Growth of Cast Iron," by Mr. J. W. Donaldson. 4 p.m.

MONDAY, JANUARY 10TH.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. Lecture, "Factory Smoke," by Mr. E. Clegg. 7.30 p.m.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Discussion on "The Value of Research," opened by Professor J. H. Andrew. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM CENTRE.—Chamber of Commerce, New-street, Birmingham. Paper, "The Optical Indicator as a Means of Examining Combustion in Internal Combustion Engines," by Professor W. Morgan. 7 p.m.

SURVEYORS' INSTITUTION.—12, Great George-street, London, S.W. 1. Paper, "The Effect on Values of Town Planning Schemes in their Various Stages," by Mr. F. G. Baxendale. 8 p.m.

TUESDAY, JANUARY 11TH.

ILLUMINATING ENGINEERING SOCIETY.—E.L.M.A. Lighting Service Bureau, 15, Savoy-street, Strand, London, W.C. 2. Paper, "Floodlighting," by Messrs. W. J. Jones, H. Lingard and T. Catten. 6.30 p.m.

INSTITUTE OF MARINE ENGINEERS.—85–88, The Minories, Tower Hill, London, E. 1. Paper, "Progress in the Development and Practical Application of Heat-resisting and Non-corroding Steel," by Sir Robert A. Hadfield. 6.30 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—The Engineers' Club, Waterloo-street, Birmingham. "Forces Set Up in Strip Rolling," by Mr. H. S. Caswell. 7 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Some Aspects of the Corrosion of Metals," by Mr. U. R. Evans. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: COVENTRY CENTRE.—Broadgate Café, Coventry. Paper, "The Optical Indicator as a Means of Examining Combustion in Internal Combustion Engines," by Professor W. Morgan. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Paper, "The Economics of Power-Production and Utilisation at Collieries," by Professor Douglas Hay. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Hotel Metropole, Leeds. Paper, "The Design of City Distribution Systems, and the Problem of Standardisation," by Messrs. J. R. Beard and T. G. N. Haldane. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—Scottish Royal Society of Arts Hall, 117, George-street, Edinburgh. Lecture, "The Applications of Electricity to Agriculture," by Dr. A. Ekstrom. 7.30 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Conditions Governing the Occurrence of Oil in Burma," by Dr. L. Dudley Stamp. 5.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIP-BUILDERS: MIDDLESBROUGH BRANCH.—Cleveland Scientific and Technical Institution, Corporation-road, Middlesbrough. "Rivets and Riveting," by Mr. W. G. Richards. 7.30 p.m.

WEDNESDAY, JANUARY 12TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Informal meeting. Discussion on "Dragline Excavators," opened by Mr. F. H. Livens. 6 p.m.

INSTITUTION OF ENGINEERS-IN-CHARGE.—St. Bride Institute, Bride-lane, Fleet-street, London, E.C. 4. Paper, "Steam Accumulator," by Mr. Stanley Hopkins. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIP-BUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. Graduate Section meeting. "The Erection of a Rotary Portland Cement Kiln," by Mr. J. E. Conner. 7.15 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Dr. Mann Juvenile lecture, "The Story of a Wireless Valve—II.," by Professor C. R. Darling. 3 p.m.

THURSDAY, JANUARY 13TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, London, S.W. 1. "Hardening," by Dr. W. Rosenhain. 7.30 p.m.

INSTITUTION OF AERONAUTICAL ENGINEERS.—Junior Institution of Engineers, 39, Victoria-street, London, S.W. 1. Paper, "Some Experiments on the Effects of Repeated Stresses on Materials," by Professor F. C. Lea. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Cavendish Café, Cornmarket, Derby. Derby Graduates' meeting. Paper, "Broaching and Broaching Methods," by Mr. E. Beaumont. 7.30 p.m.

FRIDAY, JANUARY 14TH.

CHEMICAL ENGINEERING GROUP.—Chemical Society's Lecture Hall, Burlington House, Piccadilly, London, W. 1. Paper, "Thermo-electric and Resistance Pyrometry in Industry," by Mr. J. Ainger Hall. 8 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Applied Science Department of the University, St. George's-square, Sheffield. "Gas Furnaces and their Heating," by Mr. P. Hopkinson. 7.30 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department, University College, Singleton Park, Swansea. Discussion on "Pyrometers." 7.15 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—The Engineers' Club, Coventry-street, London, W. 1. Paper, "The Internal Combustion Boiler and its Application to the Locomotive," by Mr. O. Brunler. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. "The Thermionic Valve and its Characteristics," by Mr. R. L. Kirlew. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Midland Hotel, Manchester. Annual dinner.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIP-BUILDERS.—Literary and Philosophical Society's Rooms, Newcastle-upon-Tyne. "Progress in Economy of Turbine Machinery on Land and Sea," by Sir Charles Parsons and Mr. R. J. Walker. 6 p.m.

SATURDAY, JANUARY 15TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Greenwood's Rooms, 198, Todmorden-road, Burnley. Annual social gathering. 5 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the operating machinery and plant at the Tower Bridge, London, E. 1. 2.15 p.m.

MONDAY, JANUARY 17TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: SCOTTISH CENTRE.—Royal Technical College, Glasgow. Paper, "Electric Lighting for Public Service Vehicles," by Mr. A. N. May. 7.30 p.m.

WEDNESDAY, JANUARY 19TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Junior Institution of Engineers, 39, Victoria-street, London, S.W. 1. Informal meeting. Exhibition of cinematograph films. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Students' meeting. Lecture, "The Testing of Heat Engines," by Mr. H. R. J. Burstall. 6.30 p.m.

THURSDAY, JANUARY 20TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Watergate House, Adelphi, London, W.C. 2. Graduates' meeting. Paper, "Mixture Distribution in Multi-cylinder Petrol Engines," by Mr. J. N. H. Tait. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Hotel Metropole, Leeds. Paper, "The Construction of Sewers in Tunnel," by Mr. J. Clemishaw. 7.30 p.m.

FRIDAY, JANUARY 21ST.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Paper, "The Use and Economy of High-pressure Steam Plants," by Professors A. L. Mellanby and W. Kerr. 6 p.m.

MONDAY, JANUARY 24TH.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, Westminster, London, S.W. 1. Lecture, "Mechanical Engineering in the Army in Relation to the Duties of an Ordnance Mechanical Engineer," by Major A. R. Valon. 7 p.m.

A.M.I.E.E. EXAMINATION.—The next examination will be held on March 30th, 31st, and April 1st, 1927. Candidates must be either students or graduates of the Institution or have lodged with the secretary a duly completed form "E" for election as associate member. Entry forms for the examination, which must be completed and returned by February 1st, and particulars regarding election to membership of the Institution may be had on application to the Secretary, the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2.